NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

A BUSINESS PROCESS ANALYSIS OF THE SURFACE NAVY'S DEPOT MAINTENANCE PROGRAM

by

Donald S. Northrup

December 2015

Thesis Advisor:	Nicholas Dew
Second Reader:	Matthew D. Kremer

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY ***(Leave blank)***	**2. REPORT DATE** December 2015	**3. REPORT TYPE AND DATES COVERED** Master's thesis	
4. TITLE AND SUBTITLE A BUSINESS PROCESS ANALYSIS OF THE SURFACE NAVY'S DEPOT MAINTENANCE PROGRAM			**5. FUNDING NUMBERS**
6. AUTHOR(S): Donald S. Northrup			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number NPS.2015.0047-IR-EP7-A.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words)

To maintain the Surface Fleet, the Navy spent approximately $7.2 billion in FY2015 and requested $7.8 billion for FY2016. In response to years of costs overruns and missed deadlines, the Navy wants to make better use of these funds by shifting from executing Multi-Ship Multi-Option Contracts with cost-plus fee types to Multi-Award contracts with fixed-price fees. The new contract choice will increase competition and shift risk to the contractor. This thesis conducts an in-depth analysis of the contract change process during execution of depot maintenance availabilities using five ships as case studies. It uses lean principles and lessons from buyer-supplier relationship studies to recommend improvements and to answer two questions. Is the Navy's current construct prepared to execute a new contract strategy? Is this the best decision to reduce cost and meet schedule requirements? The thesis concludes that process improvement is required before shifting to a new contract strategy, and that improving the working relationship with the contractor is paramount to process improvement.

14. SUBJECT TERMS depot maintenance, naval surface forces maintenance, MSMO, MAC-MO, lean six sigma, Japanese supplier partnerships			**15. NUMBER OF PAGES** 101
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

A BUSINESS PROCESS ANALYSIS OF THE SURFACE NAVY'S DEPOT MAINTENANCE PROGRAM

Donald S. Northrup
Lieutenant, United States Navy
B.S., United States Naval Academy, 2009

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

NAVAL POSTGRADUATE SCHOOL
December 2015

Approved by: Nicholas Dew, PhD
Thesis Advisor

Matthew D. Kremer, Lieutenant Commander, USN
Second Reader

Donald Summers, Academic Associate
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

To maintain the Surface Fleet, the Navy spent approximately $7.2 billion in FY2015 and requested $7.8 billion for FY2016. In response to years of costs overruns and missed deadlines, the Navy wants to make better use of these funds by shifting from executing Multi-Ship Multi-Option Contracts with cost-plus fee types to Multi-Award contracts with fixed-price fees. The new contract choice will increase competition and shift risk to the contractor. This thesis conducts an in-depth analysis of the contract change process during execution of depot maintenance availabilities using five ships as case studies. It uses lean principles and lessons from buyer-supplier relationship studies to recommend improvements and to answer two questions. Is the Navy's current construct prepared to execute a new contract strategy? Is this the best decision to reduce cost and meet schedule requirements? The thesis concludes that process improvement is required before shifting to a new contract strategy, and that improving the working relationship with the contractor is paramount to process improvement.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

ATP	authorization to proceed
BAWP	Baseline Availability Work Package
CFR	conditions found report
CAS	Contract Administration Services
CAO	Contract Administration Office
CMAV	continuous maintenance availability
CMP	Class Maintenance Plan
CNO	Chief of Naval Operations
CNRMC	Commander Naval Regional Maintenance Center
COPA	change order Price Analysis
CPARS	contractor performance appraisal report system
CT	contracting team
FAR	Federal Acquisition Regulation
FRP	Fleet Response Plan
IGE	independent government estimate
JFMM	Joint Fleet Maintenance Manual
JSP	Japanese Supplier Partnerships
KTR	short for contractor
LMA	lead maintenance activity
LOD	lost operational days
MAC-MO	Multiple Award Contract-Multiple Order

MSC	Master Specification Catalog
MSMO	Multi-Ship, Multi-Option
MT	maintenance team
NAVSEA	Naval Sea Systems Command
NMD	Naval Maintenance Database
NSA	Naval Supervisory Authority
OPNAV	Office of the Chief of Naval Operations
PE	Port Engineer
PM	Project Manager
RCC	request for contract change
RFP	request for proposal
RMC	Regional Maintenance Center
SBS	Shipbuilding Specialist
SURFMEPP	Surface Engineering Maintenance Planning Program
SURFOR	Commander Naval Surface Forces
TYCOM	Type Commander

ACKNOWLEDGMENTS

This thesis was written with the support of many individuals and entities, whom I want to thank.

Starting with my wife, thank you for allowing me to tackle a difficult issue that I felt strongly about, even though it meant a “laid back” shore duty turned difficult at times.

SURFOR N43 staff was instrumental to my starting this project and then gaining the connections necessary to do it right.

SWRMC staff, specifically Mrs. Myriam Pata, Mr. John Rocks, Mrs. Katie Adkins, Mr. Carl Shrode, LCDR Duward Dunn, LT Eric Shuey allowed me large amounts of their precious time, and I appreciate it. All of their insights and data collection were instrumental to completing my thesis, and cannot I thank them enough.

Thank you to the staff at NPS including ARP, travel, and those professors who allowed me to pick their brain about topics. Last, thank you to Dr. Dew and LCDR Kremer, my Advisor and Second Reader, who gave up inordinate amounts of time to assist me with completing this. Words cannot express my gratitude.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

The Navy spent approximately $7.2 billion dollars in fiscal year (FY) 2015 and requested $7.8 billion to maintain the surface fleet in FY16 (Department of the Navy, 15). The department is facing complications with an ever-expanding role for the surface fleet coupled with uncertain budget conditions (Beardsley, 2015). Analyzing processes to find inefficiencies is a means by which the Navy can satisfy multiple stakeholders, successfully complete the nation’s missions, and stay within prescribed budgets.

There is a history of shifts in the surface Navy’s depot maintenance processes and procedures (Balisle, 2010). Currently, the Navy is in the process of shifting from cost reimbursement contracts with a multi-ship, multi-option contract (MSMO) award structure to a fixed-price contract with a multi-award, multi-option contract (MAC-MO) award structure (Duncan & Hartl, 2015). The shift encourages competition from pre-approved contractors while enforcing strict contract standards, work specifications and risk acceptance by the contractor (Duncan & Hartl, 2015).

When choosing contract types the Federal Acquisition Regulations (FAR) is explicit about items that should be considered. For this particular case two items are apply:

- *Cost analysis.* The government should compare a cost estimate to the contractor to provide the basis for negotiations. It is essential to consider the amount of uncertainty within the scope of work to apply a fair amount of responsibility on the contractor for cost.
- *Type and complexity of the requirement.* The higher the complexity of the work should result in a higher assumption of risk by the government. As a requirement recurs the risk should shift, in time, to the contractor.

(FAR 16.104)

The Navy has been conducting maintenance on ships for a long time thus these two considerations imply the shift to fixed price contracts based on recurring requirements for ship maintenance and a corresponding shift of risk to the contractor is logical.

This thesis analyzes the process of changing the contract during execution of depot maintenance availabilities using five ships as case studies. It uses lean principles and highlights three specific types of waste:

- Defects (Mistakes)–Multiple areas are identified where defects are creating rework and slowing the process.
- Waiting/Queueing–The theory of constraints shows that the process is not optimized and cannot be without increasing resources and increased cooperation.
- Untapped Creativity and Human Potential–Increased use of metrics will allow better analysis of the process and objective review of the contractor.

Buyer-supplier relationship case studies are used to parallel depot maintenance to historical examples. Specific areas of concern include:

- Recurring competition instead of cultivating efficiency
- Firm focus regarding cost instead of full value chain analysis
- Communication between the contractor and government is sporadic and problem driven

Methods of improving the relationship and ultimately improving the process are recommended.

The thesis uses the analysis of the process to answer two key questions: Is the Navy's current construct prepared to execute a new contracting strategy? Is this new contract strategy the best decision for reducing cost and keeping schedule? Using the FAR items for consideration the thesis concludes that process improvement is required, as a basis for estimating costs and accurately articulating complex requirements, before shifting to a new contract strategy. Additionally, improving the working relationship with the contractor is paramount to process improvement.

II. THE PROCESS

The depot maintenance process is delineated in the *Joint Fleet Maintenance Manual* (JFMM; Executive Director SUBMEPP, 2015), but I provide a consolidated breakdown here to enable the rest of my thesis to be understood in context. The process is extensive and incorporates a myriad of players that all have effects on the ultimate product that is a definitized contract (Duncan & Hartl, 2015).

The purpose of this chapter is to describe the depot maintenance process in detail by breaking it up into parts. I start with a basic overview of corrective maintenance conducted by the Navy. Then, I address the players to include overarching organizations, ship's maintenance teams, their roles and responsibilities. Next, I discuss the advanced planning process, including how a work item is formed and how a contract is definitized prior to start of a Chief of Naval Operations Directed Selected Restrictive Availability (SRA). Finally, I describe execution, which includes the Request for Contract Change (RCC) process. This process is the means by which the contract is changed after definitization.

The Business Dictionary defines Definitization as "Final determination of an agreement, arrangement, or contract, such as about its cost, duration, scope, and/or go no-go decision" (Definitization, n.d.). In the case of U.S. Navy ships conducting contracted maintenance in a private shipyard, each ship has its own definitized contract which encompasses all of the work which is going to be conducted in that specific Availability. Whenever each individual work item needs to be changed the entire contract must be adjusted to reflect changes in scope, cost or procedure.

A. THE BASICS

In this section, I provide a breakdown of the levels of maintenance and the ways in which the Navy employs these types of maintenance to accomplish the objective of sustaining the surface fleet.

1. Levels of Maintenance

There are different types of maintenance such as preventive, repair or even periodic preventive maintenance. This thesis concentrates on repair or corrective maintenance. Each type of maintenance can be handled at levels defined in the JFMM which are broken down by the entity performing the maintenance.

a. Organizational Maintenance

This is the lowest maintenance level. This is maintenance conducted by the organization, such as the ship's crew and is generally the least difficult or time consuming (JFMM; Executive Director SUBMEPP, 2015). The Navy has strayed from this for corrective maintenance, which I will elaborate on in the literature review (Office of the Chief of Naval Operations (OPNAV), 2010).

b. Intermediate Maintenance

Intermediate maintenance is repair work that exceeds organizational-level capability or capacity (OPNAV, 2010). The performers of this type of maintenance are government employees, in some cases sailors. In general, this is coordinated by and executed by the RMC. (CNRMC, 2012)

c. Depot Maintenance

Depot maintenance is "maintenance that requires skills, facilities, or capacities normally beyond those of the organizational level and intermediate level, and is performed by a naval [shipyard], [private] shipyard original equipment entity/agent, or NAVSEA-designated overhaul point." (OPNAV, 2010)

d. Emergent Maintenance

Emergent maintenance is maintenance that is conducted with little or no notice to restore a failed mission-essential system or component-to-readiness condition, but does not require execution by a naval shipyard/private shipyard. (OPNAV, 2010)

2. Availabilities

Availability is when a ship's response time capability is reduced to allow maintenance to be conducted by outside sources (OPNAV, 2010, p. 24). Availabilities can be conducted pierside at a U.S. Navy–controlled maintenance pier or in a private/public drydock or shipyard.

a. CNO-Directed Availabilities (CNO Avail)

CNO-directed availabilities fall into two categories: major and minor. Availabilities of six months or longer in duration that are performed by industrial entity under NAVSEA oversight or contract administration is a major Availability. Availabilities that are shorter than six months, scheduled by and under SURFOR management is a minor availability. Major CNO Availabilities can be large-scale overhauls or modernizations including planned, engineered, and incremental availabilities. Minor Availabilities include Selected Restricted Availabilities (SRA), Docking SRA, Phased Maintenance Availabilities (PMA), Extended Docking SRA (EDSRA), or Pre-Inactivation Restricted Availabilities (PIRA). (OPNAV, 2010)

b. Continuous Maintenance Availabilities (CMAV)

CMAVs are conducted by Surface Ships for approximately two to six weeks. It is generally executed while the ship is in port and is scheduled once per non-deployed quarter (OPNAV, 2010).

For continuity of data and analysis, this thesis concentrates on corrective maintenance and modernization conducted at the depot level in CNO directed Availabilities. CMAVs inherently have a shorter planning process than a CNO directed Availability due to the short time frame in which the Availability is conducted. Due to the differences in duration and complexity, I have removed CMAVs from my data analysis to ensure the data is not manipulated by the inherent differences in these two types of Availabilities.

B. THE PLAYERS

1. The Organizations

These are the organizations which are intimately involved in the depot maintenance process and each should be addressed in turn so that someone can gain a full understanding of the process.

There are multiple players that impact the Surface Navy's depot maintenance program, so I have broken this section up into areas of interest. The first includes the organizations so that I establish the stakeholders and the chain of command as it relates to reporting requirements and responsibilities. The second section is the Maintenance Team, Contracting Team and those members that affect an Availability throughout pre-planning and execution.

a. Commander Naval Surface Forces

Commander Naval Surface Force (SURFOR) is also known as the Type Commander (TYCOM), and their responsibility is to man, train and equip the Navy's surface fleet. Coupled with the RMCs, SURFOR is responsible for budgeting funds for alterations, rejuvenation, repair, and maintenance availabilities, and the sustained material readiness of its assigned ships. Under the direction of the CNO and assigned Operational Commanders, SURFOR and the RMCs manage funds for pre-availability planning during the execution of the availabilities. SURFOR works in concert with the operational commanders to schedule ships for deployment and other operational assignments. In addition, they are actively engaged in scheduling ship repair and planning engagements that directly involve the ship (Executive Director SUBMEPP, 2015).

SURFOR provides the planning funds for the assigned ships Maintenance Team for availability planning. Once the availability work package has been identified and accepted, SURFOR provides the funding for completion of repairs and modifications. The Port Engineers, working with their assigned maintenance teams, are responsible for oversight of all SURFOR advance planning. They work closely with the contract administrative team, known as the contracting team, to execute the terms and conditions

of contracts for their assigned ships (Executive Director SUBMEPP, 2015). I address the Port Engineers' role in further depth in the maintenance team section.

b. Naval Sea Systems Command (NAVSEA)

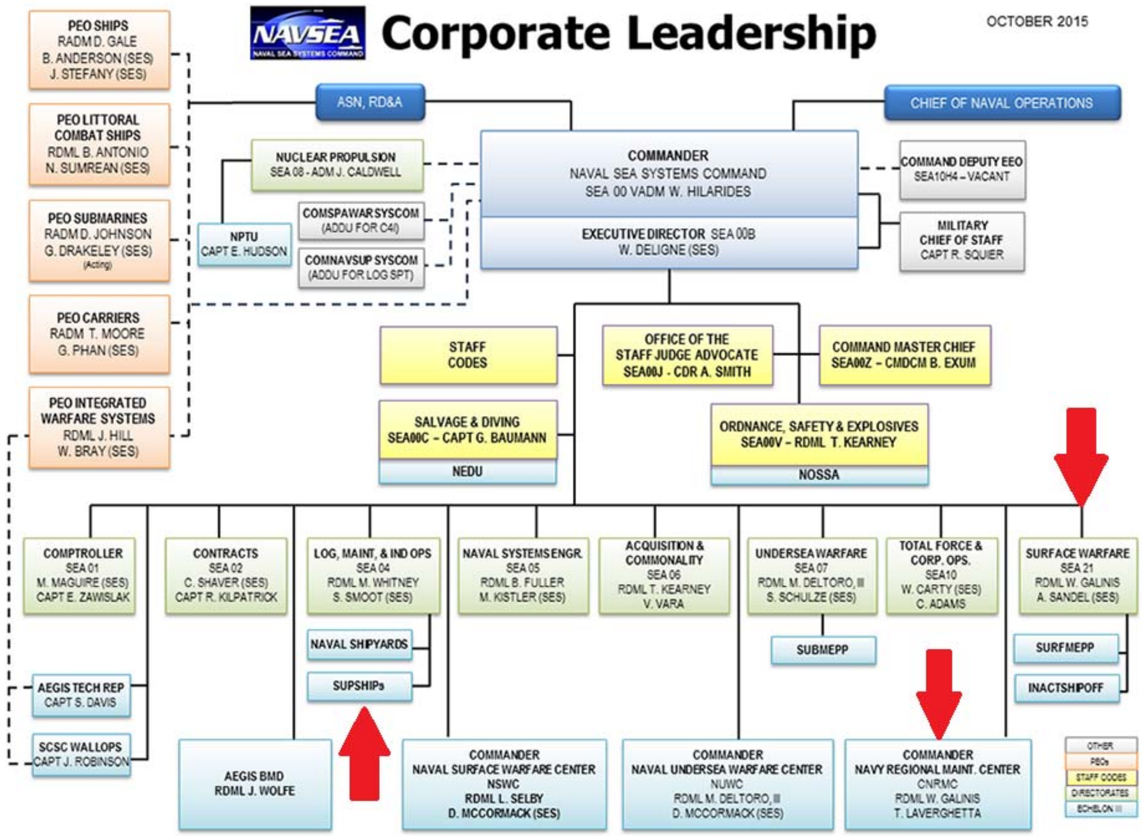
Responsible to the CNO, NAVSEA's "basic mission as related to ship modernization, repair, and maintenance is to provide acquisition, engineering, logistic and material support for the Navy. As the technical and engineering authority for ships of the Navy, NAVSEA, in support of the designated Program Executive Office (PEO), is responsible for the life cycle management of Navy ships, submarines, craft, and boats, including the following" (Executive Director SUBMEPP, 2015):

- Developing maintenance plans for each ship class.
- Supporting fleet maintenance officers in scheduling ships for availabilities.
- Managing alteration development and executing the NMP.
- Providing acquisition, engineering and technical authority and Contract Administration Quality Assurance Program assistance to the fleet maintenance officers and RMCs.
- Operation of the NSYs, SUPSHIP, and RMC Contracting Offices.

(Executive Director SUBMEPP, 2015, p. II-I-3-13)

Figure 1 is a breakdown of the NAVSEA corporate organization chart. This provides an overview of where SEA 21, SURFMEPP, SUPSHIP and the RMC are in the chain of reporting and authority within the NAVSEA organization. SURFMEPP reports to SEA 21, or the Surface Warfare Directorate for NAVSEA. SUPSHIP reports directly to the Logistics and Maintenance directorate (NAVSEA 04) for NAVSEA.

Figure 1. Corporate Leadership of Naval Sea Systems Command



This figure illustrates the command structure of Naval Sea Systems Command and the rest of the players that report to NAVSEA. Source: Naval Sea Systems Command (NAVSEA). (n.d.2015). NAVSEA corporate leadership [Chart]. Retrieved from http://www.navsea.navy.mil/WhoWeAre/Headquarters.aspx

c. Surface Warfare Directorate of NAVSEA (SEA 21)

SEA 21 is Commander Naval Sea Systems Command's (COMNAVSEASYSCOM) coordinator of surface ships. Its mission and program summary is as follows:

> SEA 21 integrates maintenance strategies, modernization plans, training needs, and technical, logistics, and programmatic efforts to best manage the lifecycle of U.S. and partner Navy surface ships and systems from fleet introduction through transfer or disposal…NAVSEA 21 is the dedicated life-cycle management organization for the Navy's in-service surface ships and is responsible for managing critical modernization, maintenance, training and inactivation programs. SEA 21 provides wholeness to the Fleet by serving as the primary technical interface; ensuring surface ships

are modernized with the latest technologies and remain mission relevant throughout each ship's service life. The organization also maintains inactive ships for future disposal, donation, or transfer, to include follow-on technical support to our partner navies. (NAVSEA, Program Summary, Mission Statement, n.d., p. 1)

d. Regional Maintenance Centers (RMC)

The Navy RMC is responsible for the administration and technical oversight of the contract. This duty is coordinated with the Supervisor of Shipbuilding Conversion and Repair (SUPSHIP) (Executive Director SUBMEPP, 2015, p. II-I-2-3). The Commander Regional Maintenance Center is the central authority over the individual RMCs. Its mission and goals are as follows:

> We deliver quality cost-wise material readiness to support U.S. Naval forces worldwide…The command leads the RMCs in developing and executing standardized maintenance and modernization processes, instituting common policies, and standardizing training in an effort to sustain a consistent business model across the RMCs and, ultimately, to provide cost-effective readiness to the Navy's surface ship fleets…CNRMC is an Echelon III command, reporting directly to the Commander, Naval Sea Systems Command (NAVSEA), and works closely with NAVSEA's SEA 21 directorate and the Surface Maintenance Engineering Planning Program (SURFMEPP) command for planning and execution of surface ship maintenance and modernization. (Commander Naval Regional Maintenance Center [CNRMC], 2015, p. 1)

The RMCs have two different responsibilities. They coordinate the Intermediate Maintenance and they are the executor of the contracts. These two separate duties are why their strategic goals include the following:

- Support mission readiness by delivering quality ship maintenance on time and on cost
- Become a stronger partner with the surface fleet by delivering measured performance
- Develop our RMC workforce as we reconstitute RMC capability and capacity
- Mentor and return Sailors to the Fleet with Journeyman technical abilities
- Enhance enterprise-wide understanding of proper maintenance processes (CNRMC, 2015)

e. Surface Maintenance Engineering Planning Program (SURFMEPP)

The mission of SURFMEPP is to "provide centralized surface ship life-cycle maintenance engineering, class maintenance and modernization planning, and management of maintenance strategies" (NAVSEA, SURFMEPP, Program Summary, n.d., p. 1). In essence, the purpose of SURFMEPP is to monitor and coordinate Surface Ship life-cycle maintenance by creating products which enable maintenance fluidity. Some of the products it produces are as follows:

- Baseline Availability Work Package (BAWP)–This consists of the work items required in accordance with the Fleet Response Plan (FRP) maintenance cycle for each ship type.
- Change Management Documentation–This is an analysis and review of the risk of deferral of maintenance items to subsequent maintenance cycles.
- Class Maintenance Plan (CMP)–This plan contains the repair and assessment tasks required to be performed in preparation for a ship class to meet life cycle maintenance and material requirements.
- CNO Availability Completion Reports–These reports are a review of the financial and technical requirements of a completed availability. Identification of growth and new work is recorded to support future plans.
- Master Specification Catalog (MSC)–This is a master catalog of Class Standard Work Templates and associated Independent Government Estimates to streamline and standardize contract management.
- Ship Sheets–These are documents of labor and material costs associated with each ship's CNO availability maintenance requirements.
- Technical Papers–These are a notional plan of a ship's maintenance.

(NAVSEA, SURFMEPP, Core Products, n.d.).

f. Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP)

The supervisor of shipbuilding, conversion, and repair (SUPSHIP) is an Echelon 3 shore command reporting to commander NAVSEA. Their mission is "to administer and manage execution of Department of Defense (DOD) contracts awarded to assigned commercial entities in the shipbuilding and ship repair industry" (Supervisor of Shipbuilding, Conversion & Repair, 2015, p. 1).

Their functions and tasks are as follows:

- Serve as DOD's designated Contract Administration Office (CAO) responsible for performing Contract Administration Services (CAS) for all DoD contracts awarded to assigned contractors.
- Enforce contract requirements, ensuring contractors, and the government, satisfy their contractual obligations.
- Work with contractors and government activities to facilitate greater quality and economy in the products and services being procured.
- Manage the complexities and unique demands of ship construction and nuclear ship repair projects by performing the following non-CAS functions for Navy Program Executives Officers (PEOs), the Fleet, and NAVSEA headquarters:
    - Project Management: Coordinate response to non-contractual emergent problems; coordinate activities of Pre-Commissioning Crews, Ship's Force and other government activities; communicate with customers and higher authority regarding matters that may impact project execution.
    - Technical Authority: Serve as NAVSEA's waterfront Technical Authority responsible for providing government direction and coordination in the resolution of technical issues.
    - Contract Planning and Procurement: Participate in acquisition planning and assessment of contractor qualifications.
- Apply a standard methodology for determining overall physical progress of Navy Ships under contract.
- For each shipbuilding program, apply risk assessment methodology for determining the allocation and effective mix of SUPSHIP resources (Supervisor of Shipbuilding, Conversion & Repair, 2015, pp. 1–4)

2. Representation

The JFMM designates authority in each type of Availability to ensure clear lines of responsibility and communication. This thesis concentrates on the CNO Availability conducted in Private shipyards. In Table 1, this particular situation designates that the RMC and SUPSHIP will share responsibility of Naval Supervisory Authority and the Contractor is the Lead Maintenance Activity. These roles and responsibilities are further explained below.

Table 1. Authority for Each Availability Type

Maintenance Availability	NSA	LMA
CNO Public (1)	NSY	NSY
CNO Private (1)	RMC/SUPSHIP (2)	Contractor
Non-CNO Public (3) (4)	RMC/NSY	RMC/NSY Fleet Maintenance Activity (FMA)
Non-CNO Private (3)	RMC/SUPSHIP (2)	Contractor
Emergent/Voyage repair (4)	RMC/SUPSHIP/NSY	FMA/RMC/NSY/Contractor
New Construction	SUPSHIP	Contractor
AIT availabilities	RMC/SUPSHIP/NSY	FMA/RMC/NSY/AIT Contractor
Other (4)	N/A	FMA/Ship's Force

Source: Executive Director SUBMEPP. (2015). *Joint fleet maintenance manual.* Portsmouth, NH: Department of the Navy, p. II-1-2-4.

a. Naval Supervisory Authority

The Naval Supervisory Authority (NSA) is the responsible entity for management and verification of all work accomplished by all parties in execution within the given availability, and is the main contact for all work. The NSA provides the management required to ensure the work in the assigned availability is approved and finished in compliance with technical requirements and maintenance/modernization policy. In addition, the NSA ensures all assigned work meets the timetable, quality, and environmental/safety requirements (Executive Director SUBMEPP, 2015). For the purposes of this thesis, I concentrate on CNO-directed private availabilities which result in sharing of NSA responsibility between SUPSHIP and RMC designated personnel. In most cases the NSA is assigned by the Fleet Maintenance Officer and Type Commander (SURFOR). An NSA is assigned for any CNO-directed availability and all contracted work where the majority of maintenance occurs onboard ship (JFMM, Executive Director SUBMEPP, 2015).

NSA Responsibilities include but are not limited to:

- Coordination with other Maintenance Activities through an authorized MOA.
- Single point of contact for the LMA and shipboard personnel.
- Verify completion of work for milestones, key events, end of availability, availability departure report based on documentation provided by all maintenance activities.
- Based on the amount of work accomplished, the NSA may also assume the role of the LMA.
- For CNO availabilities, the NSA shall:
- Participate in all work definition, planning and completion conferences.
- Facilitate planning efforts. Ensure detailed planning and integration of the work package is accomplished to provide a schedule that incorporates the work and testing of all organizations involved in the availability. The schedule shall address work definition, key events, shipchecks, job summary, material preparations and strategy preparations. Identify milestones with sufficient detail to measure intermediate progress toward each key event. Ensure orientation briefings and training is conducted as necessary so that personnel understand applicable project processes and requirements. Identify their appropriate points of contact.
- Prior to availability completion, verify all authorized work has been completed unless voided/deferred. For work performed by contractors, ensure all provisions of the contract have been fully executed.
- During work execution, review all changes to specifications and work items to ensure requirements are met.
- Participate in critiques and problem investigations as necessary.

(JFMM, Executive Director SUBMEPP, 2015, p. II-1-2-2)

b. Lead Maintenance Activity

"The lead maintenance activity is the single activity responsible for work being accomplished on U.S. Naval ships during any type of availability. For work conducted during periods in which the NSYs or RMCs do not have oversight, an LMA is designated" (JFMM, Executive Director SUBMEPP, 2015, p. II-1-2-5). Since this thesis

concentrates on CNO-directed Availabilities, the contractor serves as the LMA (Table 1). LMA Responsibilities include but are not limited to:

- Conduct or attend routine progress review meetings with all assigned repair activities. Identify and resolve coordination problems and work conflicts. Advise the appropriate maintenance sponsors (e.g., NSA, NAVSEA, TYCOM, AIT Sponsor, Ship's Program Manager) of significant quality, cost and schedule impacts and problems.

- Coordinate work and testing controls to include Work Authorization Forms, tagouts and test sequencing.

- Integrate the work of all repair activities. For CNO availabilities, this includes an integrated schedule. For non-CNO availabilities, an integrated schedule may be used, based on the complexity of the work as determined by the LMA. The schedule shall ensure adequate time is provided for crew training.

- Report work status to Maintenance Brokers.

- Request assistance via Maintenance Broker as needed for outside activity performance.

- Coordinate preparations by assigned repair activities for all key events to include verification signature checklists of readiness to start.

- Track progress of all maintenance activities.

- Coordinate crane operations, pier laydown areas, dry dock work areas and resolve other real estate conflicts which may impede efficient execution of the availability.

- Provide sea trials agenda, with all repair activity input, for ship Commanding Officer's concurrence and Type Commander approval.

- Maintain a list of activities authorized to work on the ship the LMA is responsible for and ensure the list is updated weekly or on an as-needed basis. Ensure activities working on ship have the proper credentials, work schedule and pedigree (authorized maintenance activity) prior to being added on the work authorization list.

- Ensure maintenance activities performing maintenance on assigned ships have proper MOA, Standard Work Practices, NAVSEA standard items and/or Strategic Systems Programs Alteration authorization in place and that the MOA, Standard Work Practices, NAVSEA standard items and/or Strategic Systems Programs Alteration authorization address required support for work authorizations and work control.

- Direct maintenance providers to their proper points of contact.
- Attend all production/maintenance management meetings to communicate/resolve priorities, problems, job interferences and issues.
- Define, identify and provide resolution to coordination problems and work conflicts between the Maintenance Managers, Maintenance Activities, Maintenance Brokers and the ship. Provide a copy of all Departures From Specifications to Ship’s Force Quality Assurance Officer and the Type Commander (TYCOM) N43 organization.
- Participate in critiques and problem investigations (e.g., Trouble Reports) as necessary.
- Conduct Ship’s Force and contractor orientation briefings and training as applicable prior to commencement of shipboard work.
- Appoint a Ship Safety Officer to chair the Ship Safety Council and coordinate work and testing that affects ship’s conditions and prevention and protection from fire and flooding

(JFMM, Executive Director SUBMEPP, 2015, p. II-1-2-5)

c. Ship’s Responsibility

The ship is responsible for the following:

- Monitor all maintenance activities to ensure they are on the master authorization list.
- Ensure a current master authorization list is maintained by the Ship’s Duty Officer.
- Provide the LMA with information on ship brokered work so all activities are placed on the master authorization list.

(JFMM, Executive Director SUBMEPP, 2015, p. II-1-2-6)

OPNAV further defines two more responsibilities of the CO of the ship:

- Ensure that quality maintenance is performed by other activities by providing assistance and oversight, as necessary, to ensure that published quality assurance standards are adhered to.
- Ensure documentation of all maintenance actions, whether accomplished by ship's force or by other activities.

(OPNAV, 2010, p. 2 Encl. 1)

3. The Maintenance Team

Each ship is assigned a production team by the RMC that is charged with coordinating the ship's needs with a contractor. The maintenance team's principal roles are as follows:

- Management of Ship Maintenance which includes validation and coordination of the ship's Current Ship's Maintenance Project (CSMP) and Availability Work Package (AWP). They also coordinate initial estimates for work items to facilitate planning of availabilities.
- Budgeting of Ship Maintenance which includes preparing the Maintenance and Modernization Business Plan. This document recommends a budget for the ship's fiscal year requirements.
- Availability coordination which is developing the plan and coordinating scheduled availabilities within the resources provided by the TYCOM.
- Meet with TYCOM Representatives and SURFMEPP at A-410 to review the ship's BAWP, CSMP, Availability Duration Estimate, active DFSs, Class Advisories and routines/services. The CSMP will be reviewed and evaluated for branding.
- Screen and broker any mandatory CMP requirement uploaded to the CSMP after Mid Cycle Review (A-410) within ten (10) days of receipt into the Information Technology (IT) screening and brokering system.
- When required, provide CMP configuration data corrections to SURFMEPP.

(JFMM, Executive Director SUBMEPP, 2015, p. II-I-3-13)

a. The Port Engineer (Ashore Ship's Maintenance Manager)

The port engineer is also referred to as the ashore maintenance manager in the JFMM. Port engineers are assigned by the type commander and are responsible for validating, screening, and brokering all maintenance and modernization, including assessments, which require off-ship assistance. They must ensure the Project Manager (PM) has visibility of all assigned work. There is also a Combat Systems Port Engineer who conducts the same functions specifically for Surface Ship Combat Systems. (JFMM, Executive Director SUBMEPP, 2015, p. VII-7-4)

Specific items they are accountable and responsible for include the following:

Accountable:

- Leads the Maintenance Team and maintains frequent contact with the Commanding Officer and conducts personal observations of shipboard conditions. Establishes and maintains an effective communications plan with the ship during deployment.

- Validates all off ship maintenance for assigned ship(s), including off-ship assessments.

- Develops initial planning estimates based on information such as return costs from similar jobs and Government prepared or approved estimates.

- Screens/schedules work candidates to the right time period and maintenance availability based on the MMBP, operational schedule, material readiness requirements and cost benefit analysis.

- Develops Business Case Analysis and generates applicable Engineering Services Request, provides advice and serves as the ship's point of contact for access to technical expertise for all ship maintenance and modernization requirements, including the development of Ship Changes.

  (JFMM, Executive Director SUBMEPP, 2015, p. VII-7-4)

Responsibilities:

- Communicates, coordinates and tracks ship and applicable class problems.

- Makes recommendations to the ship's Commanding Officer and management on any deferred work items.

- Coordinates maintenance availability scheduling and execution.

- Develops and schedules work packages. Recommends resolutions to CNO Availability scheduling issues.

- Screens work candidates to appropriate level of maintenance. Reviews assessment results for inclusion in work packages.

- Assists the NSA with technical close out and availability work certification. Assists ship in achieving maintenance phase exit criteria.

- Supports and participates in work specification review.

  (JFMM, Executive Director SUBMEPP, 2015, p. VII-7-4)

b. The Project Manager

The Project Manager (PM) is the principle representative assigned to the maintenance team by the Naval Supervisory Authority, or in this case, the Navy Regional Maintenance Center (Table 1). The PM is the administrator of the contract (JFMM, Executive Director SUBMEPP, 2015, p. VII-7-3).

The JFMM delineates what the PM is accountable for and their responsibilities:

Accountable:

- Supports the Ashore Ship's Maintenance Manager in the performance of maintenance and modernization.
- Accepts or rejects work candidates to scheduled availability periods and performing activities in accordance with guidance. Integrates work candidates to form optimized work packages.
- Serves as the advanced planning manager for contracted maintenance during CNO availabilities and scheduled CMAVs conducted at contractor or Government depots.
- Briefs Ship's Force on the status of all work, by work item.
- Acts as business agent with other activities on availabilities and contracts assigned that includes ensuring that TYCOM funds are utilized properly. Evaluates all Technical Analysis Reports (TAR) and supports the Contracting Officer in contract negotiations. Acts as assistant funds administrator (when designated in writing from the RMC Commanding Officer) for assigned availabilities and contracts.
- Documents delay and disruption charges and lessons learned
- Manages ship repair and modernization work items, job orders and contracts assigned by progressing and evaluating all work to anticipate, prevent and minimize delays, resolving all problems that affect the end cost, quality, schedule and performance of assigned availability or contract.
- Reviews all work accomplished by assigned Shipbuilding Specialists to ensure compliance with regulations, directives, instructions, and policies as well as to ensure that intended work is practical and necessary.
- Reviews contractors work schedules, manning curves, material ordering/receipt schedules and special tasking/equipment requirements. Evaluates contractors' proposals prior to and during contract execution.

Takes corrective actions to eliminate conflicts and prevent work stoppages. Identifies and initiates action to correct, prevent, and minimize delays, resolving all problems that affect quality, schedule and contractor performance.

- Obtains work authorizations for growth and new work. Work authorizations may be in the form of naval messages, speed letters, letters, other transmittals or documents. In the case of growth work, the authorization may be verbal, a memo at a meeting or a telephone call. Verbal authorizations should be documented with a memorandum for the record.

- Maintains a ledger notebook or spreadsheet to assist in funds administration. For each contract modification initiated in the work package, the Project Manager shall show the title of the item, cite the proper funding authorization and account and show the Government estimate.

- Reviews contractor condition reports, exceptions list, and contract modifications for approval.

- Coordinates, schedules and administers advance planning functions. Analyzes work package to maintain available dates and minimize premiums.

- Coordinates review of both Government and contractor estimates for “reasonableness and fairness”. Recommends alternate contracting vehicles if applicable.

- Provides inputs for funding requirements and serves as the Maintenance Team funds manager for CNO availability preparation and execution.

- Prepares the business case analysis for growth and new work recommendations and recommends resolutions to the Ashore Ship’s Maintenance Manager (Port Engineer). Reviews the authorization and funding, and submits information to the contracting officer for negotiation on growth and new work.

- Reviews condition reports and evaluates submitted time and cost estimates for accomplishment or deferral in concert with the Ashore Ship’s Maintenance Manager's concurrence.

(JFMM, Executive Director SUBMEPP, 2015, p. VII-7-3)

Responsibilities:

- Provides supporting information for Business Case Analysis for new work.
- Participates in CSMP/DFS/BAWP mid-cycle reviews, coordinates mid-deployment shipchecks, and participates in scoping conference
- Progresses Cost/Schedule Status Reports.
- Assists with the authorization of growth and new work.

(JFMM, Executive Director SUBMEPP, 2015, p. VII-7-3)

c. The Shipbuilding Specialist

"Shipbuilding specialists are individuals who possess a primary trade background but effectively perform across trade lines in two or more trade skill disciplines. Team assignments are made to balance trade expertise appropriately with the type of work in the project. A wide variety of comprehensive duties and responsibilities are assigned to these individuals who are expected to act as decision-makers with comprehensive knowledge of each work item assigned" (Waterfront OPS, 2011, p. 20). Shipbuilding Specialists are assigned the following duties and responsibilities, some of which are delegated among a group:

- Attends meetings, resolves production problems, develops scope of work requirements, assists in the development of Government TARs and negotiation positions, assesses contractor capabilities, work progress and performance, provides technical support to the ACO, participates in claims avoidance and provides other technical support as required.
- Receives and investigates contractor reports, assists with the development of the Government's technical response, requests engineering support, prepares necessary contract modifications, develops the Government cost estimates, estimates the delay and disruption that may occur because of a contract modification, assists with negotiation preparation relative to TARs and contract modifications (as authorized by the ACO), provides the ACO support in negotiations and maintains records of actions taken.
- Perform/witness Government "G" notification points, identified in the work specifications, when the contractor calls them out. Accomplish random Product Verification Inspections (PVI) utilizing checklists or an attribute system to determine contractor compliance with the quality and

technical requirements of the work specifications/contract. Write a Corrective Action Request when nonconformities are detected.

- Determines the physical progress, as a percentage of work completed, of each work item and each contract modification assigned. This information is updated weekly in a comprehensive progress report that is used in calculating the contractor's entitlement to progress payments as well as in evaluating the contractor's schedule performance.

- Provides positive lessons learned along with feedback related to deficient or inefficient work specifications or work authorizations to the appropriate planning group for use in improving future procurements.

- Conducts oversight coordination and inspection of work-related environmental issues associated with Ship's Force and contractor's operations.

- Conducts safety inspections jointly with the contractor, Ship's Force and Government Environmental Safety and Health (ESH) Representative(s).

- Maintains a Significant Events Log.

- Provides written reports to support Award Fee Evaluations and CPARS.

(JFMM, Executive Director SUBMEPP, 2015, pp. VII-7-5 —VII-5-6)

For the entire list of action items for a SBS, see the Appendix.

d. *The Contracting Officer and Contracting Specialist Team*

There are three categories of contracting officers. The "contracting officer" exercises the authority of entering into, administering, and/or terminating contracts and makes corresponding determinations and findings. "Administrative Contracting Officer (ACO)" and "Termination Contracting Officer" refers to a Contracting Officer who is either administering the contracts or settling terminated contracts. "A single contracting officer may be responsible for duties in any or all of these areas" (FAR 42.302).

"[The] ACO is assisted by a contracts specialist and cost monitor who reside in close proximity to the location where the Availability is being performed. Administrative functions may be delegated to individuals with special technical or trade skill backgrounds who will obtain, or have received, additional training in the relevant

contract administration areas" (JFMM, Executive Director SUBMEPP, 2015, pp. VII-2–10). This is referred to as the Defense Acquisition Workforce Improvement Act (DAWIA) certification level and each contracting officer or representative must be certified to the level required for their responsibilities. "[The] complex technical requirements of ship repair and modernization require the assignment of trade skill and technical personnel from a variety of functional disciplines who must work closely with the project [manager] and contracting officer to ensure that the specified terms and conditions of the contract are complied with and that upon final closure of the contract there are no non-conformant or exceptions to the work items except those that have been approved for deviation or waiver by the contracting officer" (JFMM, Executive Director SUBMEPP, 2015, pp. VII-2-10 —VII-2-12).

C. ADVANCED PLANNING

Advanced planning for a CNO-directed Maintenance Availability is conducted in accordance with the JFMM, Vol. 2, Chapter 2, Appendix D: Surface Ship Availability Milestones. Advanced Planning is important to a smoothly conducted Availability, dictates an on-time award, and, if poorly followed can be detrimental to on-time completion.

Two years in advance (A-720), the type commander works with the fleet commander to establish the availability schedule. Between this milestone and 18 months in advance, Modernization funding is confirmed and then procurement begins to prepare for ship changes. At approximately A-420 the planning yards submit funding requests for the work that is already assigned. At this point in the process this pertains to major alterations that have been planned well in advance by the Maintenance Team such as Combat Systems Suite Upgrades. At A-410 SURFMEPP conducts the mid-cycle review which determines the major work items required to be conducted in accordance with the Baseline Availability Work Package (BAWP). This document takes into account historical data and ship class problems to pinpoint the periodic items that need to be assessed or repaired. The Maintenance Team is required to address all of the items in the

BAWP, either scheduling them in the upcoming availability or deferring them to a later date. At the completion of this meeting, the A-360 letter is published addressing these items.

Initial Funding for Planning is provided at this time in conjunction with a Target price for the availability which has been established by the TYCOM (SURFOR). At A-270 incremental funds are released to support Long Lead Time Materials (LLTM) and 50 percent of all planned work should have been developed and turned over to the planning yard. The planning yard for MSMO contracts is the contractor, and it is a third party planner for MAC-MO contacts. Well in advance of the Availability start date—170 days—a Risk Assessment letter is prepared by the RMC, which is sent to the CNRMC and TYCOM addressing all risks associated with completion of the Availability. This includes Budget, Schedule, Contractor capability, and other pertinent factors affecting the contractor’s ability to meet schedule and cost targets. A-120 is known as the “lock” date because new work is no longer sent to the planning yards after this date. Two weeks later, all work specifications have been written by the planners.

From A-240 to A-106, specifications are sent from the planners back to the government in batches for review. This review ensures the work specification meets government requirements and is the actual work that was contracted for. The Project Manager, Shipbuilding Specialists, and Port Engineers conduct these reviews and return to the planners if needed. A Final specification is generated and included in the contract. At 35 days before the contract begins, the entire contract is definitized. Technically, work cannot start in the Availability without a definitized contract completed by the Authorized Contracting Officer. In later chapters, I address the procedure for starting an Availability without a definitized contract (JFMM, Executive Director SUBMEPP, 2015, pp. II-II-2D-1—II-II-2D-27).

D. EXECUTION PHASE

During execution of the contract, the contractor leads daily update meetings to inform the customer of the status of individual work items executed by the contractor and his or her contracted subs. The contractor also uses the Naval Maintenance Database

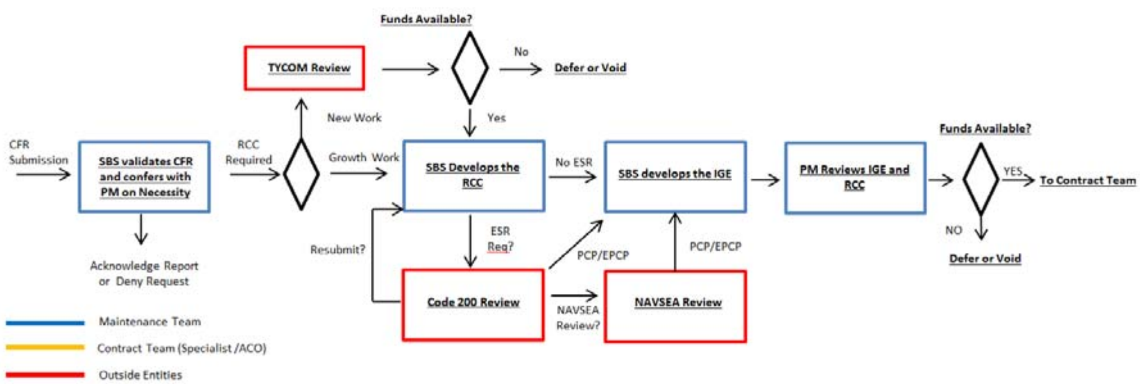
(NMD) to communicate with the government. This system is the means for initiating changes to the contract, approving and negotiating materials, man hours and total cost. A contract change to adjust cost, schedule, and man-hours expended, or to initiate new work starts with a conditions found report (JFMM, Executive Director SUBMEPP, 2015, pp. II-I-3-24—II-I-3-27).

1. Conditions Found Report or Contractor Furnished Request

As the contractor comes upon items that are not specified in the work item, he or she documents it in a Conditions Found Report (CFR). Contractors are encouraged by the government to identify discrepancies on the work site. There is no limitation to the work the contractor can point out, which opens up the possibility for erroneous CFRs and massive influx at the outset of an Availability. I discuss this further in the analysis of the RCC process in Chapter IV (NAASCO, 2012).

Figure 2 is the first part of a two-part process map that tracks the contract change from CFR to COPA. The second part of the process map is Figure 3. Each of these is closely mapped and articulated so that further analysis in future chapters can be understood in context.

Figure 2. RCC Cycle Process Stage 1



This is a map of the process from CFR to COPA prepared by LT Donald Northrup. Data for this chart pulled from the *Joint Fleet Maintenance Manual*. Adapted from Executive Director SUBMEPP. (2015). *Joint fleet maintenance manual.* Portsmouth, NH: Department of the Navy.

When work is beginning, this report can be a confirmation of the conditions which existed when the shipcheck was conducted in the planning phase. In some cases, the CFR defines a new requirement which was not part of the initial scope of work. For example, when the contractor opens a tank or inspects equipment which was in operation at the time of the check the scope of work was not likely clearly defined at the time of writing. When this type of CFR is reported, a Request for Contract Change (RCC) must be generated by the government.

By SWRMC instruction SWINST 4730.2B, CFR responses are to be processed in less than three days unless there are mitigating circumstances. By NAASCO contract Special Terms and Conditions, any condition found which warrants a CFR is required to be submitted within three days of discovery (NAASCO, 2012).

2. Request for Contract Change

The Shipbuilding Specialist (SBS) is required to review all CFRs for relevance and determine the necessity and requirement for generating a RCC. In this determination they must also decide whether the work is considered growth work or new work.

- "Growth Work: Any additional work that is identified after contract award or definitization that is related to a work item included in the contract award. Growth does not include pre-priced options or reservations that were specifically identified in the solicitation or defined package." (Executive Director SUBMEPP, 2015)
- "New Work: Any additional work identified after contract award or definitization that is not related to a work item that was included in the original contract award." (Executive Director SUBMEPP, 2015)

Any work that is determined to be new work must be forwarded to TYCOM for approval, and any increase in funds outside of the original target for the Availability is also required to be approved by the TYCOM.

The SBS writes the Request for Contract Change using a template that is pulled from the Master Specification Catalog (MSC) that is maintained by SURFMEPP. This is to ensure standardization and avoidance of missing substance such as standard items. If the work is outside of the technical expertise of the SBS, or requires a procedure which

must be developed by technical authority, it is forwarded to RMC Code 200 as an Engineering Service Request.

3. Engineering Service Requests

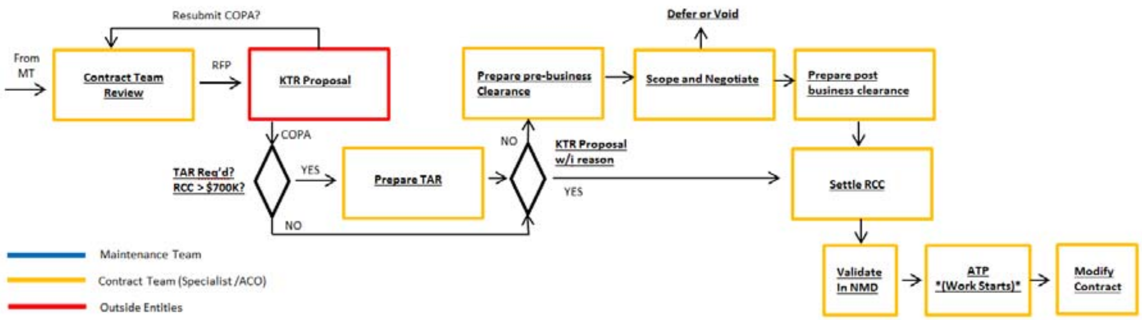
In-depth technical review is required when a requirement cannot be clearly defined by the MT. In some instances a Class or ship issues arises requiring adjudication from technical authority which requires an entirely new procedure be developed before execution of work. These procedures are known as a Process Control Procedure (PCP) or Extended Process Control Procedure (EPCP) for critical systems. A contractor is not authorized to commence work without an approved procedure for conducting work within the work specification, which would normally be delineated by the MSC (JFMM, Executive Director SUBMEPP, 2015, p. II-I-3R-2).

If higher technical authority is required, such as a class-wide issue or an issue that is derived from the originating shipyards design decisions, the ESR can be forwarded on to NAVSEA technical authority for review. (JFMM, Executive Director SUBMEPP, 2015, p. II-I-3-37).

4. Request for Proposal and Change Order Price Analysis

The SBS develops the RCC and the independent government estimate and then forwards these to the Project Manager for review. The PM reviews all RCCs in an Availability and then forwards each to the Contracting Specialist as they are ready for Request for Proposal (RFP). Once an RFP has been issued, the Contractor prepares the Change Order Price Analysis (COPA) which describes the work, man hours, and cost of the proposed change to the contract. There is a possibility that this process goes back and forth a couple of times. The government may disagree with elements of the COPA and they may be able to show historical precedent to disprove the COPA, in which case the contractor can adjust the COPA or wait for scope and negotiation to occur. This back and forth may occur, which ultimately adds to the RCC cycle time.

Figure 3. RCC Cycle Process from COPA to Modification of Contract



This figure is a map of the process from CFR to COPA prepared by LT Donald Northrup. The data for this chart was pulled from the *Joint Fleet Maintenance Manual*: (Executive Director SUBMEPP, 2015)

5. Technical Analysis Review

If the contractor's estimate is greater than $750,000, or the ACO directs, a Technical Analysis Review (TAR) is required which establishes the details between the IGE and the COPA which need to be adjudicated. This is a mechanism for the government to ensure all jobs with significant cost increases are closely scrutinized to ensure the contractor fully understands the scope of work and has properly allocated the man hours, material and costs associated with that work. These can take a couple hours or even a few days in some cases while the PM, SBS and contracting team investigate the COPA, review historical data and clarify requirements (CNRMC, 2015).

6. Negotiation

The ACO and its team of Contracting Specialists confer with the Project Manager preparing for negotiations. The preparations involve verifying historical precedence and comparable work items executed by the contractor on similar ship classes. This is what is known as the Pre-Business Clearance. Hours may be spent in preparation for a negotiation which only lasts a few minutes, but this is dependent on the complexity of the work and the ability to produce historical data. In addition, there is some time that is spent in this stage waiting for available negotiation periods. During certain periods of an

availability, such as in the first 60 days where there is an influx of Requests for Contract Change, this can be the longest time frame in the process. In this step in the process, there could be rescoping discussions to complete as much work as possible within budget or work can be deferred to another Availability to wait for available funds (CNRMC, 2015).

7. Authorization to Proceed to Modification of Contract

Once negotiations are complete and the contractor and the government agree on material costs and man hours expended for a defined scope of work, the government issues an authorization to proceed. This is an authorization to start work even though it has not been written into the contract yet. This is because each individual change to the contract must be processed in order, and then appropriate changes are made to the contract in turn. In this time frame, the ACO and their team also prepare the post-business clearance which is a summary of the negotiations that occurred, the data brought to the table by the contractor and the government, and the agreed-upon scope and cost (CNRMC, 2015).

III. LITERATURE REVIEW

A. FEDERAL ACQUISITION REGULATIONS

The Federal Acquisition Regulation (FAR) articulates the government rules and regulations when acquiring products or services.

1. Contract Types

There are multiple contract types defined and regulations for usage of each in the FAR, but I only outline the two here that are being used by the Navy for services.

a. Firm Fixed Price (FFP)

Firm fixed price contracts were used exclusively in the late 1980's to through early 1990's. Some of the issues which drove the shift to cost reimbursement contracts were schedule flexibility, cost overruns and general relationship between the government and the contractor.

The FAR defines a firm-fixed price contract as follows:

> A firm-fixed-price contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract. This contract type places upon the contractor maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon the contracting parties. The contracting officer may use a firm-fixed-price contract in conjunction with an award-fee incentive for performance or delivery incentives when the award fee or incentive is based solely on factors other than cost. The contract type remains firm-fixed-price when used with these incentives (FAR 16.202-1).

The FAR continues with the following:

> A firm-fixed-price contract is suitable for acquiring commercial items or for acquiring other supplies or services on the basis of reasonably definite functional or detailed specifications when the contracting officer can establish fair and reasonable prices at the outset, such as when

- There is adequate price competition

- There are reasonable price comparisons with prior purchases of the same or similar supplies or services made on a competitive basis or supported by valid certified cost or pricing data

- Available cost or pricing information permits realistic estimates of the probable costs of performance

- Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm fixed price representing assumption of the risks involved.

(FAR 16.202-2)

b. Cost-Reimbursement

The Surface Navy is currently using cost-plus-award fee for execution of the multi-ship multi-option service contracts. A cost-plus-award-fee contract is defined as:

> [A] cost-reimbursement contract that provides for a fee consisting of (a) a base amount (which may be zero) fixed at inception of the contract and (b) an award amount, based upon a judgmental evaluation by the Government, sufficient to provide motivation for excellence in contract performance. (FAR 16.305)

The FAR continues with the following for cost reimbursement type contracts:

The contracting officer shall use cost-reimbursement contracts only when-

- Circumstances do not allow the agency to define its requirements sufficiently to allow for a fixed-price type contract

- Uncertainties involved in contract performance do not permit costs to be estimated with sufficient accuracy to use any type of fixed-price contract

(FAR 16.301-2)

Under cost-reimbursement contracts, the government is taking responsibility for excess costs incurred in the execution of the contract because the risk is too high for the contractor to enter into a fixed-price contract. From a business standpoint, a contractor will not enter into a contract where there is high uncertainty in the work specification because onus for incurred expenses outside of the specification may reduce profit margins. Unless the contractor believes he or she can recoup those expenses via other means, such as a request to change the contract, in which case he or she may enter into a fixed-price contract with high uncertainty.

c. Factors for Consideration

The FAR list these specific factors for consideration when choosing contract type:

- If there is effective price competition, realistic pricing should become realized and fixed-price contracts should be considered.
- Price Analysis should be a basis for selection of contract and the degree to which the government is able to accurately analyze price should be considered as well.
- Cost analysis is a good basis in the absence of price analysis. The government should compare a cost estimate to the contractor to provide the basis for negotiations. It is essential to consider the amount of uncertainty within the scope of work to apply a fair amount of responsibility on the contractor for cost.
- The higher the complexity of the work should result in a higher assumption of risk by the government. As a requirement recurs the risk should shift, in time, to the contractor.
- The level of urgency of the requirement may result in the government assuming more of the risk, or it can offer incentives for performance.
- Long term contracts may dictate economic price adjustments.

(FAR 16.104)

2. Award Vehicles

Award vehicles are the means by which the government solicits for contractor proposals. There are certain requirements that preclude a contractor from bidding on the contract including experience, capability and labor force. These vehicles have been used at different times to attempt to capture advantages for the government (Balisle, 2010).

a. Multi-Ship Multi-Option contracts

The Navy is currently executing multi-ship multi-option contracts. In this system, it awards a five-year contract to a qualified contractor who becomes the sole source for depot maintenance on a specific ship class in a geographic location. For example, British Aeronautical Engineering currently holds the contract for Cruisers and Destroyers in San Diego, CA (World Maritime News, 2014). Under this Contract type, the contractor also

sub-contracts out for work he or she cannot perform, whether it is due to manning issues or lack of ability.

b. Multiple-Award Contract

"A multiple-award contract (MAC-MO) is a type of indefinite-quantity contract which is awarded to several contractors from a single solicitation. Delivery of supplies, or performance of services, is then made via an individual delivery/task order placed with one of the contractors pursuant to procedures established in the contract. All contractors receiving awards under a solicitation are given a fair opportunity to be considered for each task/delivery order issued during the life of the contract" (FAR 16.504). To date, two of these contracts have been executed.

B. MULTIPLE AWARD MULTIPLE ORDER CONTRACTS—THE FUTURE OF SURFACE NAVY MAINTENANCE PROCUREMENT (DUNCAN & HARTL, 2015)

In June 2015, Duncan and Hartl published their thesis analyzing the performance of an MSMO contract against the two pilot MAC-MO contracts that had been conducted to date. Due to the limited sample size, they were unable to draw definitive conclusions on most of the metrics they assessed. This thesis was conducted with an emphasis on contracting and performance which sheds light on the ability of each contract types ability to complete work on time and on budget.

1. Methodology

Duncan and Hartl (2015) set out to answer two questions:

- "Are MAC-MO contracts the most efficient and effective contracting method for CNO availabilities?"
- "Are MAC-MO contracts meeting their objectives?"

(Duncan & Hartl, 2015, p. 4)

In addition, they collected a series of lessons learned from CNRMC and published them in their thesis.

Duncan and Hartl (2015) took the lead from CNRMC and SURFMEPP and used four metrics to decide efficiency/effectiveness. These are Cost Growth from New Work/Growth Work, On-Time Award, On-Time Completion, and Lost Operational Days. Cost Growth is the total cost incurred during a CNO Availability beyond that which was definitized in the contract. On-Time Award is a measurement of the contractor and the government's ability to definitize the contract in accordance with the prescribed schedule delineated in the JFMM. On-Time Completion is the ability of the contractor to complete the Availability by the date agreed upon in the contract. Lost Operational Days is the amount of days a ship loses operationally, also calculated as the number of days beyond the originally planned availability duration.

The researchers consolidated the data from spreadsheets provided by SURFMEPP and CNRMC and then took these metrics to make direct comparisons between the FY13, FY14, to date FY15 and MACMO data from the two ships which had completed availabilities. In this, they used percentage for On-Time Award and On-Time Completion, and used averages for the Cost Growth and Lost Operational Days metrics (Duncan & Hartl, 2015).

The objectives used as the basis for the researchers' second question were

- Improved work package and requirements generation
- Increased price competition
- Separation of the planning function from the execution function to encourage consummate behavior

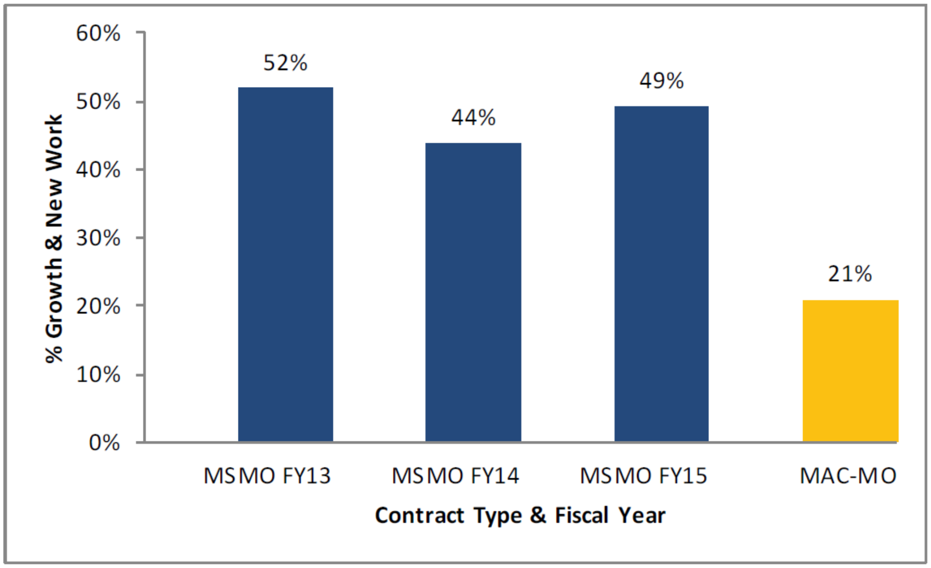
(Duncan & Hartl, 2015, p. 4)

2. Discoveries

A broad overview of their analysis was that MAC-MO displayed no definitive advantage in three out of four of the categories. Results for On-Time Award, On-Time Completion, and Lost Operational Days are were considered inconclusive for differing reasons. For Growth Work and New Work comparison, Duncan and Hartl (2015) found that the difference in performance was statistically significant.

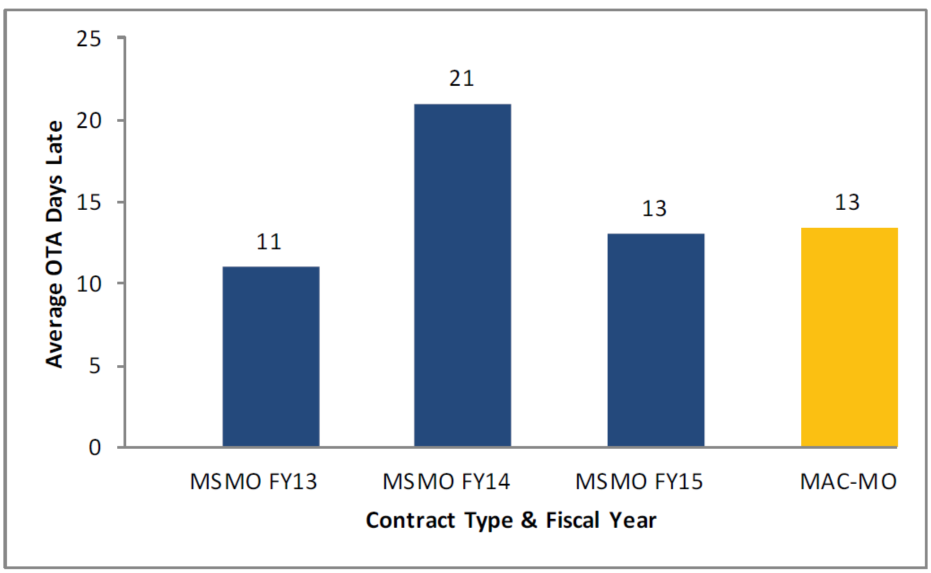
The subsequent graphs (Figures 4 through 7) show the collection of data used to make the comparisons. The Average Cost Growth for MSMO contracts across the last three fiscal years is nearly 50 percent of the total contract as compared to the 21 percent performance of the two MAC-MO contracts. This is then extrapolated to realize a potential 50–60 percent overall savings. Percentage of On-Time Completion average is 9 percent better for MAC-MO contracts, but this is not a large enough value to be deemed a success. On-Time Completion and Lost Operational Days averages are virtually identical and inconclusive (Duncan & Hartl, 2015).

Figure 4. Growth Work and New Work Comparison MAC-MO to MSMO



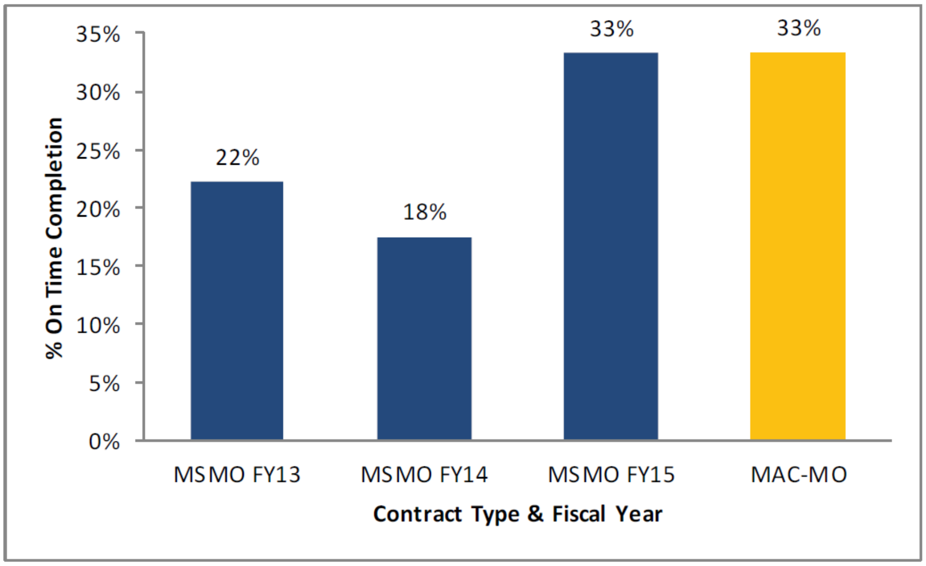
Source: Duncan, M. E., & Hartl, R. P. (2015). *Multiple award, multiple order contracts—The future of Navy surface maintenance procurement.* Monterey, CA: Naval Postgraduate School.

Figure 5. Average On-Time Award Days Comparison MAC-MO to MSMO



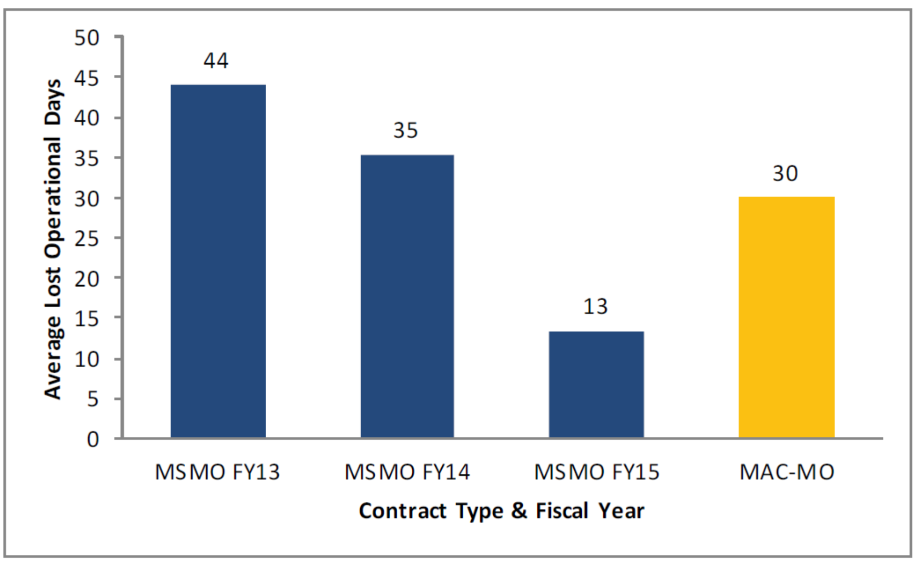
Source: Duncan, M. E., & Hartl, R. P. (2015). *Multiple award, multiple order contracts—The future of Navy surface maintenance procurement.* Monterey, CA: Naval Postgraduate School.

Figure 6. Average On-Time Completion Comparison MAC-MO to MSMO



Source: Duncan, M. E., & Hartl, R. P. (2015). *Multiple award, multiple order contracts—The future of Navy surface maintenance procurement.* Monterey, CA: Naval Postgraduate School.

Figure 7. Average Lost Operational Days Comparison MAC-MO to MSMO



Source: Duncan, M. E., & Hartl, R. P. (2015). *Multiple award, multiple order contracts—The future of Navy surface maintenance procurement.* Monterey, CA: Naval Postgraduate School.

3. Conclusions

Duncan and Hartl’s (2015) two research questions were (1) are MAC-MO contract more efficient/effective? and (2) are MAC-MO contracts reaching the stated objectives? They concluded that the answer to each of the questions was yes and no; their explanation was that most of the data was inconclusive for their four metrics of success. With the metrics being inconclusive, they could not determine that the objectives were being met, with the exception of the control of cost growth reductions. In a later chapter, I come back to these conclusions and address the relationships between their findings and my own.

C. PROCESS EFFICIENCY AND SUPPLIER RELATIONS: THE BIG PICTURE

Rendon and Snider (2008) wrote *Management of Defense Acquisition Projects* which speaks to the inherent differences in government acquisition contracting while breaking down the acquisition process and its functions. It is also an overview of systems engineering in government contracting and some inefficiencies in government contracting methods. These books are necessary for basic understanding of business process analysis and government contracting, in particular.

There are a number of famous works completed on making an organization or process more efficient. *Reengineering the Corporation* by Hammer and Champy (1993) speaks to business processes and how to evolve them with changing technology and techniques. Goldberg and Weiss (2015) wrote *The Lean Anthology*, a practical primer in continual improvement. In this work, the authors break down the Lean process of laying out an operation into its component parts and stripping it of inefficiencies to ensure there is no wasted movement.

Toyota, Honda, and their Japanese counterparts championed the lean process and served as the natural case study for process efficiency. There were a number of research studies conducted in the late ’80s and ’90s to determine why the Japanese automakers were so much more efficient than their U.S. counterparts. I break down two of these articles that point to supplier management and relations as the reasons for the success of

Japanese automakers. Surface Navy depot maintenance and auto manufacturing may not inherently alike. However, the lessons learned about the relationship between buyer and supplier in an environment of production and the lean process improvement are applicable and very useful to this thesis.

1. Japanese Style Partnerships: Giving Companies a Competitive Edge (Dyer & Ouchi, 1993)

From 1965 to 1989, Japanese automakers increased their market share of worldwide auto sales from 3.6 percent to 25.5 percent and they achieved a 20–25 percent cost advantage over U.S. automakers. Bain & Company conducted a study in 1984 which found that Japanese automakers were able to recognize a 30 percent parts cost advantage over their U.S. counterparts for similar-sized vehicles. The difference articulated in this article is U.S. automakers use traditional subcontractor relations with short term, arm's-length contracts where the supplier is not engaged regarding design and engineering practices.

The Japanese automakers recognize the benefits of a close relationship with their suppliers. They engage the supplier early in the development process to collect the suppliers ideas before establishing logistics line. The suppliers in turn assume significant responsibility and communicate constantly with the buyer. At the time of this article, U.S. automakers had reduced some of the gap by consolidating suppliers. By bringing down the number of suppliers, large benefits were recognized in less overhead for negotiations and lower shipping costs. But, this did not completely close the gap, and it could have been a fatal step if not coupled with Japanese strategy.

It can be a fatal step because reducing the number of suppliers may squeeze the market down to a number of "prime" contractors which makes the buyer beholden to the price set by the reduced number of suppliers. That is why this step must be coupled with a better working relationship with the suppliers. Dyer and Ouchi (1993) tried to characterize this Japanese-style partnership (JSP) by answering two questions:

- Why are Japanese Style Partnerships more productive than either buying supplies or customers (vertically integrating) or rotating business across numerous suppliers?

- Why are Japanese suppliers so cooperative and willing to take risks? (Dyer & Ouchi, 1993, p. 53)

Dyer and Ouchi (1993) defined a JSP as one with the following characteristics:

- Long term commitments with frequent communication including planned process improvement meetings

- "Mutual assistance and a focus on total cost not just the cost to the buyer" (Dyer & Ouchi, 1993, p. 54)

- "[Making] significant customized investments in plant equipment and personnel while sharing technical information" (Dyer & Ouchi, 1993, p. 52)

- Regular, honest sharing of technical and cost information to improve performance and pricing

- Trust-building practices such as owning stock, employee sharing, flexible legal contracts which support goal congruence and mutual trust (Dyer & Ouchi, 1993, p. 52)

a. Why Are JSPs More Productive?

To answer the first question regarding JSPs being more efficient, Dyer and Ouchi (1993) analyzed three factors: fewer direct suppliers, customized investments, and forced competition. As a result of fewer direct supplier JSPs benefit from economies of scale and experience curve benefits. Customized investments are those which make the supplier more efficient to the buyer. These include building warehouses or plants in close proximity to the buyer's needs, buying manufacturing equipment for the supplier, and investing in human capital such as liaisons to help develop inter-agency cooperation.

Forced competition is a function of keeping the supplier honest. Most companies will ensure that there is a second supplier and work to keep that supplier in business. This helps to keep innovation and price competitiveness on the table throughout the relationship. This forcing function in Japan is viewed as a contrary to their interests, but necessary. The supplier does not appreciate the constant competition and drive for innovation, but he or she also views the relationship as insurance because he or she is in

the pool of active suppliers. This is coupled with an experience curve price reduction to create a win-win for the buyer. However, JSPs are more cost focused. So instead of attempting to force the supplier to reduce prices, the buyer constantly works with supplier to reduce costs, which results in savings for both parties. This is assisted by the constant communication with the supplier regarding inefficient processes and cost-cutting ideas.

b. Why Are Suppliers More Cooperative?

Suppliers are more cooperative for the following reasons: stable, long-term contacts, career path between firms, face-to-face contact, minority ownership, and specialized investments. Stable relationships are the foundation of cooperation. If Japanese suppliers were forced to re-negotiate their contracts and compete for a contract every year there would be no trust between the buyer and supplier. Career paths between firms are another way trust is built, because they cultivate the relationships necessary for process improvement and innovation. JSPs have career progressions which incorporate positions within the supplier's organization so that employees gain perspective and build partner buy in.

JSPs believe there is no substitute for regularly scheduled face-to-face meetings to discuss inefficiencies and develop process improvement. JSPs averaged 7,235 days per year of direct contact compared to 1,129 days of face-to-face contact for U.S. companies in 1993. Specialized investments are made when the supplier has to purchase equipment specific to that buyer. If there is no purpose for the equipment that cannot be redeployed for other buyers, then the buyer purchases the equipment for the supplier. Contractually, they own the equipment and can recoup it if contracts are lost. This is another exercise in trust building because the supplier does not own specialized equipment they will never use beyond the specialized part a buyer needs.

Overall, this article elucidates the specific relationship practices employed by Japanese automakers which cultivate an environment of trust. This trust is what breed innovation and quality improvement between both companies and results in lower costs for all (Dyer & Ouchi, 1993).

There are additional articles written about this specific topic which draw the same conclusions. These are another article by Dyer for the *Harvard Business Review* in 1996 titled “How Chrysler Created an American Keiretsu” and a study by Cucmano and Takeishi for the *Strategic Management Journal* in 1991 titled “Supplier Relations and Management: A Survey of Japanese, Japanese-Transplant, and U.S. Auto Plants” (Cucmano, 1991).

THIS PAGE INTENTIONALLY LEFT BLANK

IV. DATA ANALYSIS

In this chapter, I outline the data that is available for analysis and how it relates to the process. I display a Value Stream Map and how the different entities interact to enable work to proceed. I use case studies to display ship's performance as it relates to process efficiency and then I use lean principles to increase that efficiency.

The data I display here is primarily focused on process efficiency and does not address cost. While cost is important, this thesis concentrates on reducing waste in the process to improve without regard for cost. The metrics I use relate to throughput and output. Reducing cost and schedule overruns are byproducts of operating the process at peak efficiency.

A. PROCESS MAPPING

Naval Maintenance Database (NMD) is the enterprise resource planning (ERP) tool used by the RMC to coordinate cost and scheduling information with the contractor. This system functions as a central database for cost and schedule data and it is the tool used to pass CFRs, RCCs, COPAs, ATPs and notification of finalized contract changes as revisions occur throughout execution.

NMD is flawed in certain aspects of data collection because it is largely dependent on the user to enter correct and timely information. Additionally, some metrics are not prioritized in NMD which allows the user to retroactively enter data points, enter estimates instead of accurate data or never enter data points at all.

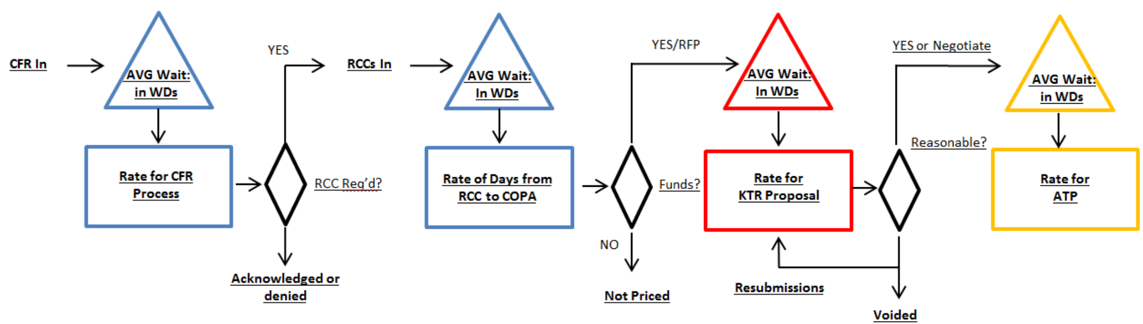
During the time I spent at SWRMC interviewing executors of the process, I found multiple parties that are actively collecting data beyond what NMD regularly provides. They have graciously provided that data for analysis of the process. Members of the contracting team for the *USS Boxer* (BXR) and *USS Makin Island* (MKI) use active time stamps in their communications with the contractor to conduct thorough analysis of contractor turnaround times. Members of the *USS Wayne E Meyer* (WEM) and *USS Harper's Ferry* (HPR) contracting teams collect similar data. In addition the *USS Pearl Harbor* (PHB) contracting team is incredibly comfortable using and manipulating NMD.

They diligently input their data points in the system to monitor their progress throughout execution. Each of these ships provides a wealth of data to map the process of reviewing and approving an RCC.

None of the data provided by these ships possesses the granularity necessary to completely analyze the process I outline in Chapter II. In light of this lack of data I have redesigned the process map to capture the steps in the process which can be analyzed. Figure 8 is the template for the redesigned process map.

Two outside entities, TYCOM Review and SWRMC Code 200 review, had to be removed from the process because of the lack of data available. All of the steps internal to the RCC review, COPA submission and ATP had to be consolidated.

Figure 8. Redesigned Process Map for Analysis



This figure is a map of the entire RCC cycle process from CFR to Contract Modification prepared by LT Donald Northrup. The data for this chart was pulled from the *Joint Fleet Maintenance Manual*: (Executive Director SUBMEPP, 2015)

As outlined in Chapter II, a CFR is generated when the contractor identifies an issue and derives a report. Work cannot begin on the identified issue until the CFR has been processed and sent to the RMC, an RCC has been subsequently generated, negotiated and resolved. An Authorization to Proceed (ATP) serves as notice that the government and contractor have agreed on the scope of work and cost data. At this point, modification of the contract is not preventing work. For the purposes of analyzing schedule creep for the entire availability, I examined the process from the time the contractor documents the issue (CFR Submission) until work begins (ATP). Follow on

research would benefit from taking into account all steps and parties outlined in Chapter II.

1. Data Standards

All data for this thesis is analyzed in the context of business days (or work days in Microsoft Excel) because the RMC and contractor standards are expressed in business days. For example, the standard for CFR submission, for those CFRs resulting in a proposed RCC, is 3 business days for MSMO contracts (NAASCO, 2012, p. 6). The standard for answering a CFR for a SBS is three business days (Waterfront Operations, 2011, p. 38). There is likely work that is conducted on the weekends. Attempting to normalize the data to account for weekends worked would require analysis of each individual work item. Additionally, working on the weekends or holidays does not change the number of business days it took to complete the task. Assessing the number of man hours spent in this process is beyond the scope of this thesis.

Excel's NETWORKDAYS function allows for analysis in business days and it account for federal holidays. This function is used when calculating the number of work days each RCC or CFR spent processing in a particular job in the process. When calculating the rate of submission for CFRs and RCCs, the number of report and changes submitted in a month is divided by the number of work days in that month to keep all data in proper units.

When calculating the rate of submission of CFRs and the rate of creation of RCCs I denote the maximum rate for each ship. In addition, I provide the rate of submission or creation at what I call steady state. Once the process is in full production the system should flow at steady state. In the beginning of the process, and in the last couple of months, rate of influx may significantly decrease. Including these months in the average rate of submission brings the overall rate down to a level which is not an accurate portrayal of the process. If the rate of influx is less than 10 percent of the maximum in the first or last months of the availability, it is not included in the average rate calculation.

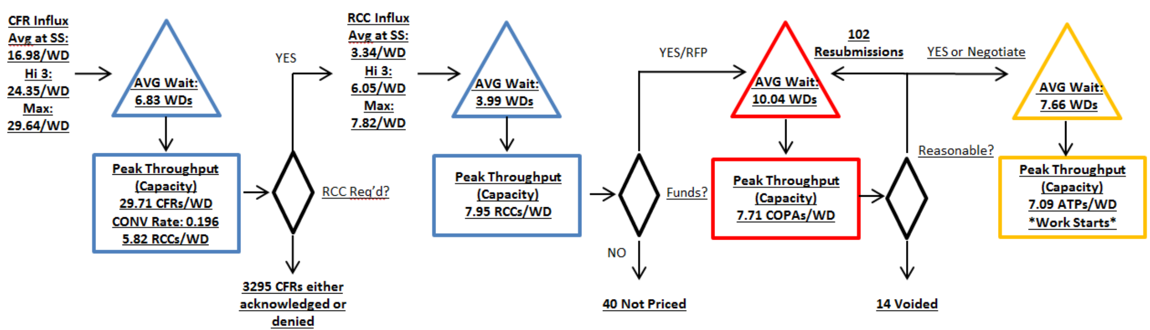
2. Case Studies

I liaised with the metrics department at Southwest Regional Maintenance Center (SWRMC) to collect data on seven ships. Five of those ships contracting teams collected more data beyond what is accessible by NMD. I use these five ships as case studies to map out their Value Stream and their process performance.

a. USS Boxer (LHD-4)

BXR is a large Amphibious Landing Helicopter Dock and her availability was large in scale. The availability consisted of 308 work items, 3085 CFRs, 740 RCCs and there were 8 SBSs assigned. Figure 9 is the process map for BXR's availability with the peak throughput rate from the availability noted.

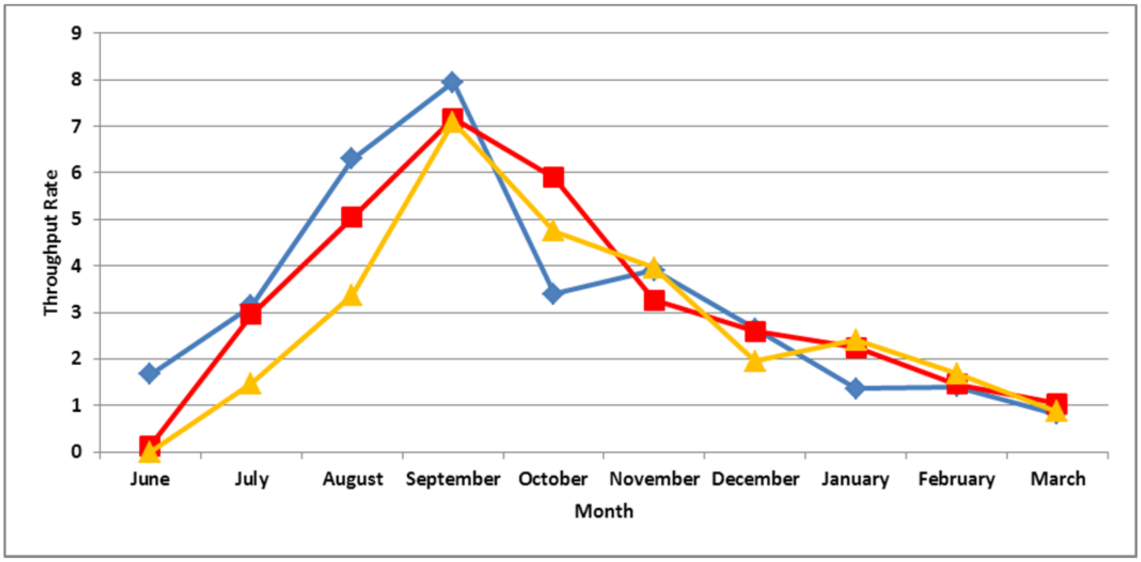
Figure 9. BXR Process Map



This figure is a process map of the RCC cycle process for the *USS Boxer* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data collected by the *USS Boxer* Contracting Team.

Figure 10 displays the throughput rate for RCCs answered (blue), COPAs Submitted (red) and ATPs (orange). CFR submission rates are calculated for each month. The highest rate of CFR influx for BXR was 29.64 CFRs per WD in the month of August. BXR's average steady state inflow of CFRs was 16.98 and the highest three months produced an average of 24.35 CFRs per business day.

Figure 10. BXR Throughput Analysis



This figure is a chart of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Boxer* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Boxer* contracting team.

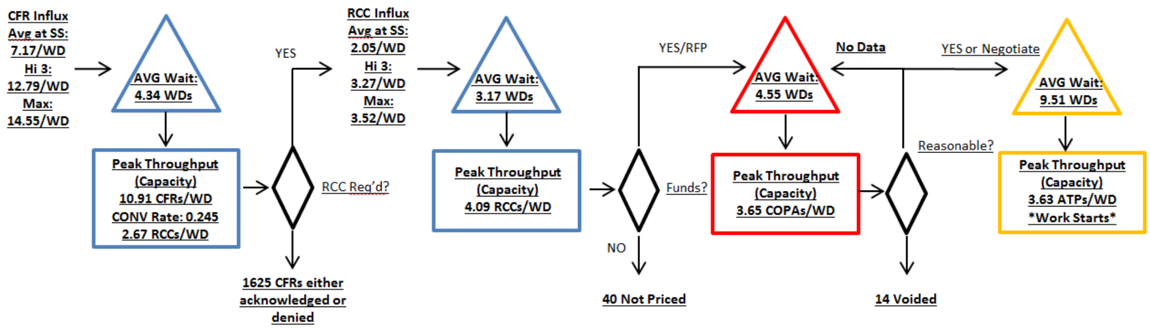
Figure 11 is the process map for BXR; including the data for each job (or step) in the process consolidated from the data provided by the BXR contracting team. In this model the ATP and Settle steps are combined because the BXR team did not differentiate between the two data points in their collection.

b. USS Harper's Ferry (LSD-49)

HPR is a medium-sized Amphibious Landing Ship Dock and her availability was medium in scale. The availability consisted of 96 work items, 2145 CFRs, 497 RCCs and there were 3 SBSs assigned. Figure 11 is the process map for HPR's availability with the peak throughput rate from each step in the availability noted.

HPR has a significant theoretical bottleneck at the MT when processing CFRs. The contracting team is likely experiencing higher processing times for individual COPAs because the output of the MT of RCCs is significantly faster than the output of the contractor.

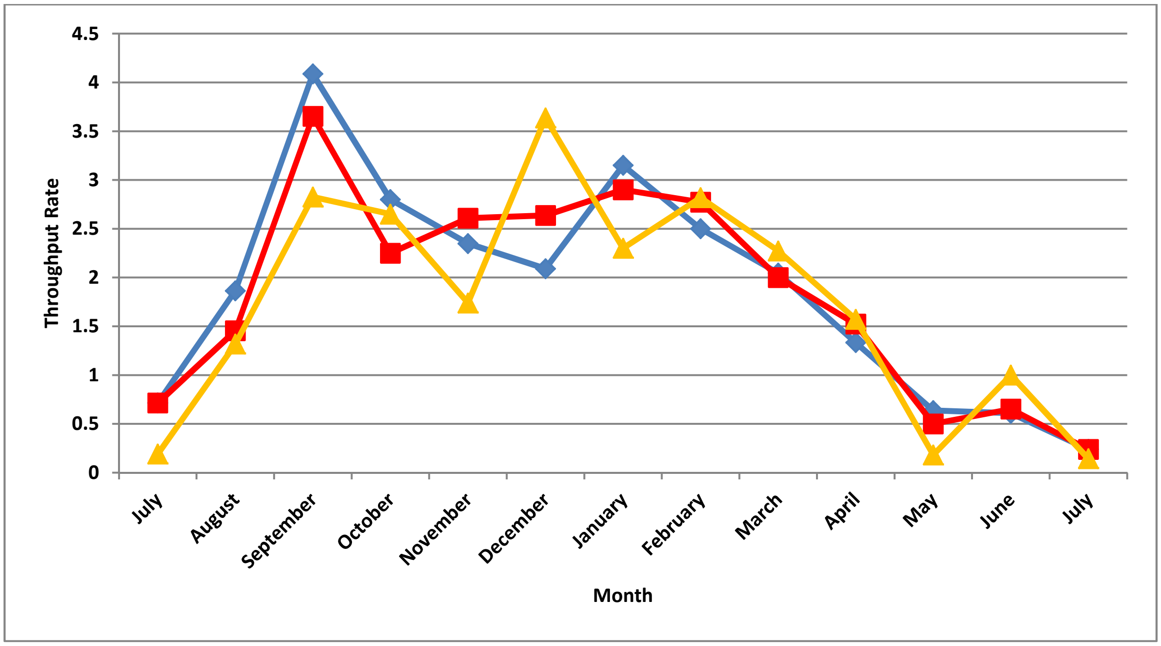
Figure 11. HPR Process Map



This figure is a process map of the RCC cycle process for the *USS Harper's Ferry* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data collected by the *USS Harper's Ferry* Contracting Team.

Figure 12 displays the throughput of the three entities. The MT drastically increases output in the first three months, which is closely followed by the contractor. The contracting team does not appear to react until nearly three months later after the MT peaks in September. This could explain the wait times experienced by HPR in processing ATPs. From February to the end of the availability, the three entities closely mimic output with the exception of a spike by the contracting team in June.

Figure 12. HPR Throughput Analysis



This figure is a chart of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Harper's Ferry* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Harper's Ferry* contracting team.

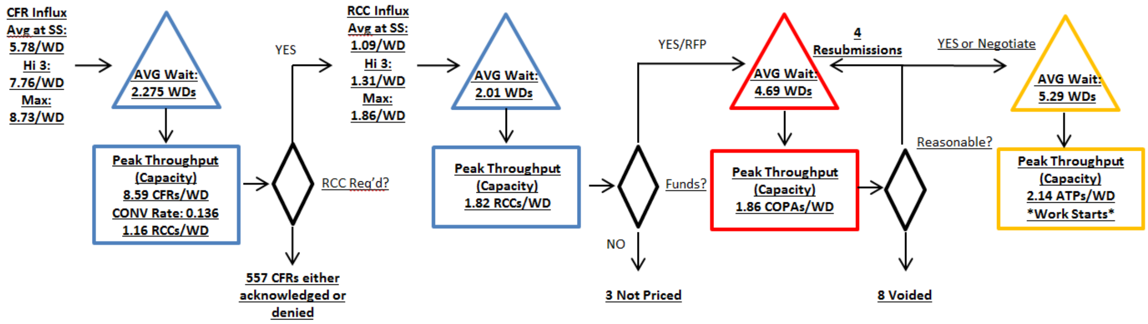
c. USS Wayne E Meyer (DDG-108)

WEM is a medium class Guided Missile Destroyer and her availability is the smallest in scale for this study. The availability consisted of 83 work items, 642 CFRs, 94 RCCs and there were 3 SBSs assigned. Figure 14 is process map for WEM's availability with the peak throughput rate from the availability noted.

In terms of theoretical capacity, WEM's bottleneck appears to be the MT during processing of CFRs. When the CFR rate is normalized by the CFR-RCC conversion rate for WEM, the rate of RCC output is 1.16 RCCs/WD. This is considerably slower than the rates of the final three steps.

WEM is also one of the only ships observed that was able to meet the three business day requirement for CFR answering. In addition, the MT was able to keep RCC processing down to less than three days.

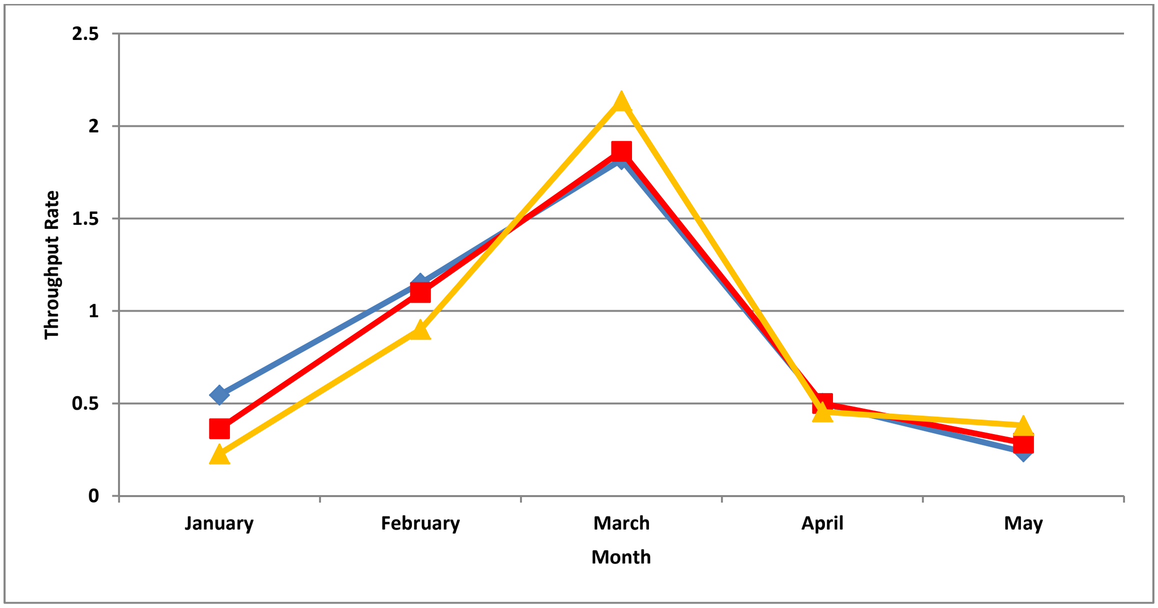
Figure 13. WEM Process Map with Data



This figure is a process map of the RCC cycle process for the *USS Wayne E Meyer* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data collected by the *USS Wayne E Meyer* Contracting Team.

For the contracting team, it appears being the bottleneck in three out of four months increased the wait times in the process to 5.29 WDs. The processing rate of the three entities follows nicely in this availability and appears to contribute to the overall performance of the availability. The WEM PM specified he was in active contact with the contractor during execution. There was never a CFR submitted he did not know about ahead of time. This can reduce setup times for the MT such as finding historical data, preparing MSC templates and preparing estimates. The reduced turnaround times for the MT correlate to this reduction in setup caused by active communication with the contractor.

Figure 14. WEM Throughput Analysis



This figure is a chart of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Wayne E Meyer* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Wayne E Meyer* contracting team.

d. USS Makin Island (LHD-8)

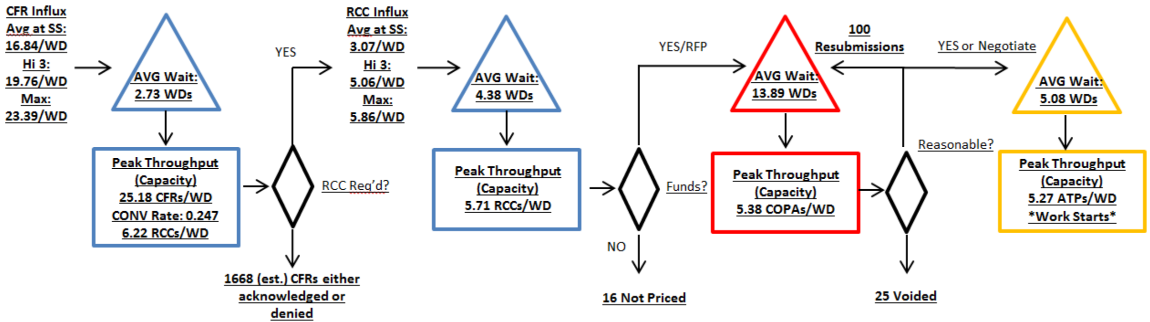
MKI's availability is on-going but the contracting team diligently collects data throughout execution so it warrants inclusion. MKI, like the BXR, is an Amphibious Landing Helicopter Dock and her availability was a little smaller than BXR. The availability consisted of 173 work items, 2215 CFRs, 547 RCCs and there were 7 SBSs assigned. Figure 16 is process map for MKI's availability with the peak throughput rate from each step noted.

The theoretical throughput displayed in Figure 15 is based off the most output experienced in a month. 25.18 is an anomaly because the next highest month realized an 18.08 CFRs/WD output and an overall steady state average of 16.84. An output of 18.08 CFRs/WD normalized to the 0.247 conversion rate yields a 4.47 answer rate, which falls in line with the RCC influx rate displayed. At 4.47 RCCs/WD, CFR review becomes the theoretical bottleneck with the contracting team being the next in line.

MKI displays a large average wait time for the contractor which is likely caused by the large number of resubmissions experienced. One hundred resubmissions is 18.3 percent of all RCCs processed. This is considerably adding to the time needed to process changes to the contract.

MKI was able to meet the CFR answering requirement of three business days but displays a considerable increase in processing time for RCCs.

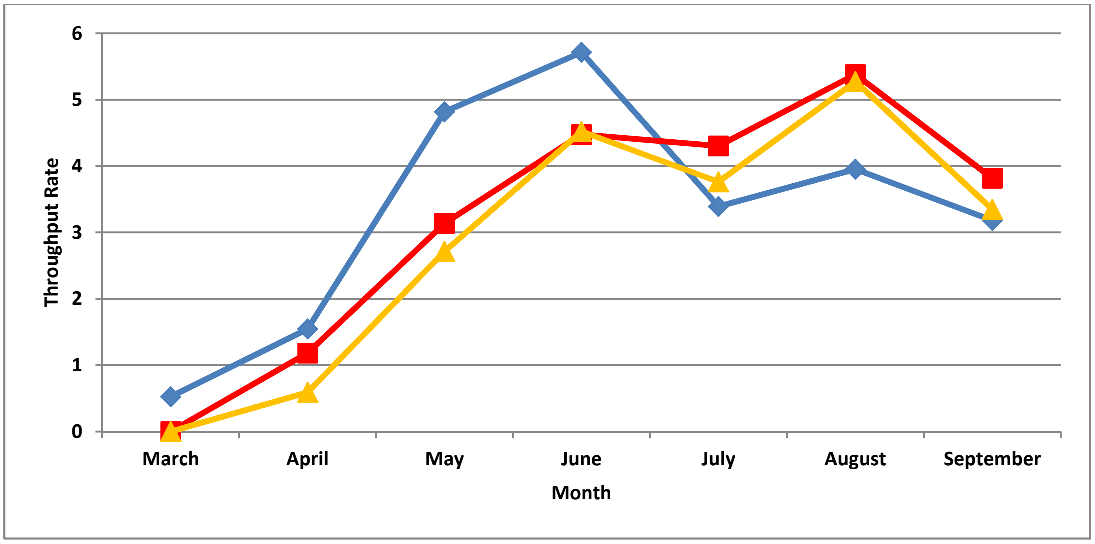
Figure 15. MKI Process Map with Data



This figure is a process map of the RCC cycle process for the *USS Makin Island* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data collected by the *USS Makin Island* Contracting Team.

Figure 17 displays the throughput of each major step throughout execution of the availability to September of this year. For the MKI the contractor and the contracting team observed a two-month delay in peak output in response to peak output of RCCs from the maintenance team. Both of these parties lagged considerably in throughput rate for the first four months before they increased output in the final three months.

Figure 16. MKI Throughput Analysis



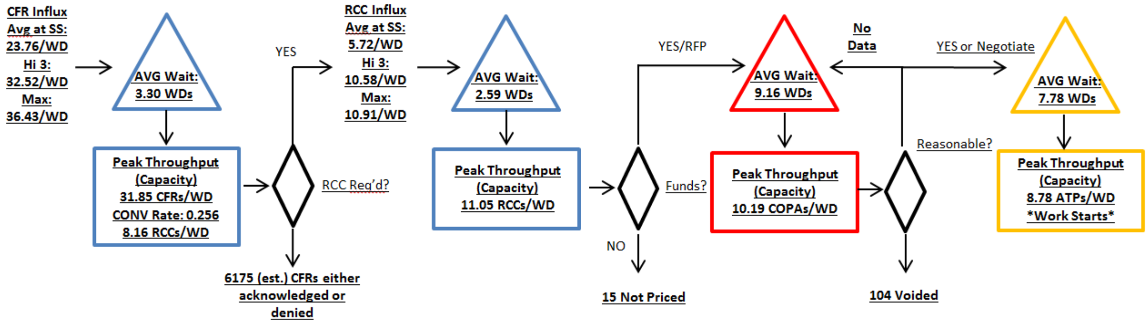
This figure is a chart of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Makin Island* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Makin Island* contracting team.

e. USS Pearl Harbor (LSD-52)

PHB, like HPR, is a medium-sized Amphibious Landing Ship Dock and her availability in on-going. This availability has been extended and has been in the going for more than a year. Her availability has grown to 750 work items, 8303 CFRs, 2128 RCCs and there are 7 SBSs assigned. I included PHB because of the wealth of data for comparison to the other ships in the study. Figure 18 is process map for PHB's availability with the peak throughput rate from each step in the availability noted.

PHB displays a bottleneck at the MT in processing CFRs closely followed by the CT processing ATPs. Voiding 104 RCCs appears to be contributing to the long wait times in processing the ATPs. Additionally, the higher output rate for RCCs from the MT appears to be contributing to the wait times experienced from the contractor. On average, PHB is close to meeting the three-day CFR response requirement and is maintaining RCC response time below three days as well.

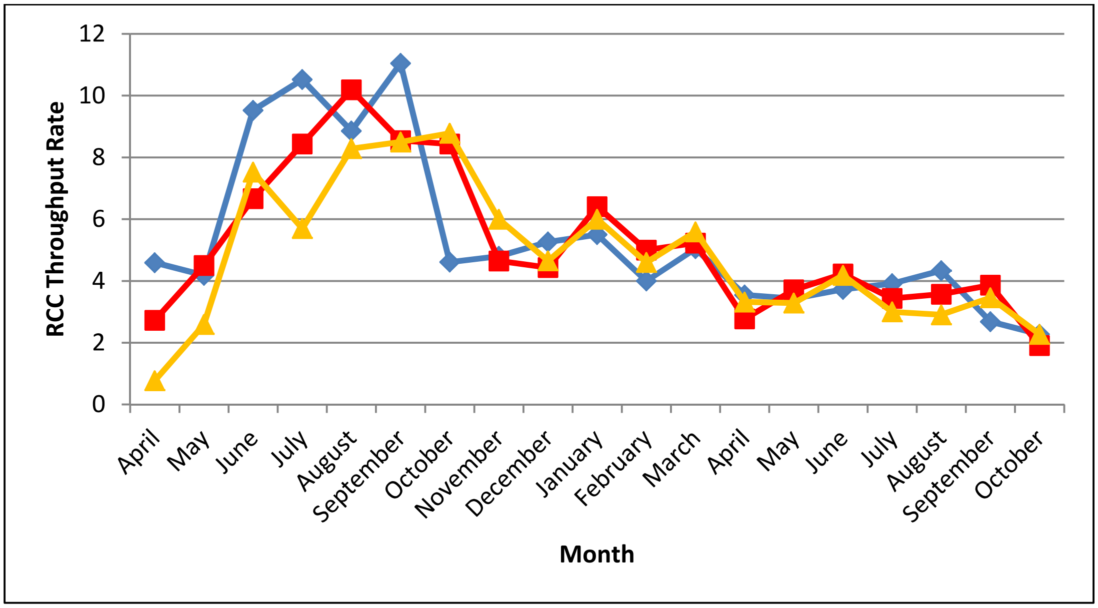
Figure 17. PHB Process Map with Data



This figure is a process map of the RCC cycle process for the *USS Pearl Harbor* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data collected by the *USS Pearl Harbor* Contracting Team.

PHBs throughput analysis displays three entities reacting to each other in a reciprocal fashion. It appears as if the contractor is lagging about one month in throughput and the contracting team is lagging two months in most cases. A regression for the contracting team in July appeared to cause a backlog which required three months of steadily increasing output. From January to October it appears the three entities are close in output, within 10 percent of each other, which more closely imitates a functioning manufacturing process.

Figure 18. PHB Throughput Analysis



This figure is a chart of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Pearl Harbor* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Pearl Harbor* contracting team.

BXR, MKI and WEM appeared to display steady growth in CFR submission and RCC creation resulting in a peak closer to the center of the availability. After the peak all of these ships declined in production until completion, with the exception of MKI. HPR and PHB displayed more rapid initial growth and steady flow throughout the availability.

3. Comparison of Ships CFR Conversion Rates

Table 2 is a comparison of each ship's rate of conversion. The first row is the total number of CFRs generated by the contractor divided by the total number of work items to start the availability. The second is the total number of RCCs divided by the total number of work items to start the availability. The third row is the total number of CFRs divided by the total number of RCCs. The last column is the number of CFRs that are specifically listed in NMD as recommending an RCC divided by the total number of CFRs for the availability. SWRMC provided the metrics for the ships.

USS DECATUR (DEC) (DDG 73) and USS HOWARD (HOW) (DDG 83)—both DDGs similar to WEM—are listed below but no process maps were created because the ships were not collecting process data with the granularity necessary to map the RCC cycle process.

Table 2. Comparison of Ship's Rate of CFR Generation and Conversion

	BXR	DEC	HOW	HPR	MKI	WEM	PHB
CFR/WI	13.34	16.60	17.47	22.34	13.80	7.73	11.07
RCC/WI	2.39	2.56	2.68	5.18	3.34	1.13	2.84
Total CFR/RCC	5.58	6.48	6.51	4.32	4.14	6.83	3.90
% CFR to RCC Conv.	19.6%	16.3%	11.7%	24.5%	ND	13.6%	ND
% Accept/Info Only	77.4%	82.4%	87.2%	74.3%	ND	85.2%	ND
% of G9 RCCs	13.8%	13.5%	70.7%	1.3%	35.9%	49.0%	10.4%

This table is a comparison between commonly used metrics prepared by LT Donald Northrup. The data for this table was consolidated from Naval Maintenance Database.

CFR/WI and RCC/WI are potential metrics for efficiency for ships. A large portion of CFRs generated are just acknowledged as accepted reports as evidenced by the % Accept or Info row. RCCs are accepted changes to the contract and there is potential for a lot of those changes to be unforeseeable. These unforeseeable RCCs contribute to more work but do not reflect the quality of the requirement in the work specification. There are a considerable number of changes which could have been prevented by developing a flawless work specification.

GAP codes are used by the RMC to try and categorize jobs. G9 is the GAP code for RCC created due to unforeseen circumstances. The flaw is this GAP code is chosen at the discretion of the administrator. For example, HPR is showing that 1.3 percent of all RCCs generated were due to unforeseen circumstances which would equate to extremely low quality work specifications. This appears to be confirmed by the ratio of RCCs to WIs being 5.18 to1 and their CFR to WI ratio being so much higher than the rest of the ships in the study. In context, this means 98 of every 100 RCCs could have been planned for before the availability. HPR appears to be performing below the standards set by the

other five ships but it also appears they are not using the GAP codes in NMD to allow for proper metric analysis.

WEM, the ship that appears to be performing the best in most aspects analyzed in this study displays the lowest RCC to WI ratio and experienced 50 percent of all RCCs being unforeseen. In comparison with the other ships, this means that 50 out of every 100 jobs could have been written to better capture requirements but they still managed to only write approximately one RCC for every WI in the availability.

Ultimately, the more CFRs and RCCs generated the more time spent processing administrative tasks instead of verifying contractor performance, conducting check points and monitoring man hour and material usage. Logically, there is a correlation between high-quality work specifications and reduction in RCCs. It does not appear to be displayed here in the data. This could be caused by the lack of usage or lack of clearly defined standards for usage of GAP codes by the maintenance and contracting teams.

The number of accepted changes to the contract throughout execution does speak to the complexity of requirements. Changing the contract a minimum of two times six out of seven ships speaks to the government’s inability to fully capture the scope of work. There are a certain number of changes to the contract which are caused by unforeseen circumstances but this cannot be accurately captured without standardized usage of GAP codes.

4. SBS Usage

The SBS is the monitor of the contractor, the CFR reviewer, the creator of the RCC, the initial cost estimator and the trade subject matter expert that liaises with the contracting officer prior to negotiation. If the ship uses the function, NMD will track the number of CFRs and RCCs assigned to each individual SBS. Table 3 displays the percentage of the total CFRs and RCCs which are assigned to each SBS for each ship in the study. Percentages may not add up to 100% due to some PMs reviewing RCCs and some ship’s possessing interim SBSs who reviewed minimal percentages of CFRs and RCCs.

Table 3. Ship's CFR and RCC assignment Table

	SBS 1	SBS 2	SBS 3	SBS 4	SBS 5	SBS 6	SBS 7
BXR CFR	15.1%	9.4%	1.5%	22.5%	7.3%	16.5%	9.0%
BXR RCC	18.1%	12.7%	4.2%	27.9%	12.6%	14.1%	10.4%
DEC CFR	58.1%	5.0%	15.4%	4.8%	4.7%	NA	NA
DEC RCC	24.0%	24.0%	19.6%	23.5%	7.9%	NA	NA
HPR CFR	55.6%	26.8%	9.9%	NA	NA	NA	NA
HPR RCC	52.8%	25.2%	21.0%	NA	NA	NA	NA
HOW CFR	27.4%	26.5%	40.7%	NA	NA	NA	NA
HOW RCC	No Data. Personnel not assigned in NMD						
WEM CFR	29.0%	39.6%	31.4%	NA	NA	NA	NA
WEM RCC	47.5%	22.8%	29.7%	NA	NA	NA	NA

This table is a comparison of percent RCCs and CFRs assigned to individual SBSs for each ship in the study prepared by LT Donald Northrup. The data for this table was consolidated from Naval Maintenance Database.

BXR was a large scope project and there is an SBS which is reviewing over 20 percent of both the CFRs and the RCCs. On both DEC and HPR there is an SBS that is conducting over 50% of the reviews of CFRs, RCCs or both. There are a few different explanations for this.

PMs are distributing the workload to try and allocate work to those that are administratively competent. Keeping those SBS that work best administratively in the RMC office while others are on the ship conducting ship checks, check points and monitoring the contractor. This explanation decouples the inherent knowledge of the work item that comes with being the SBS assigned to review, write changes and monitor work performance.

The PM may be allowing the most competent SBSs to shoulder the majority of the burden to expedite the process. If this is the case then there is a large disparity in the capability of SBSs. This implies the process will not be capable of executing at a high level until the work force is trained to the proper level to distribute work load evenly among the work force. In essence, each ship has developed an individual bottleneck due to inexperience.

As an example, Table 4 displays those SBSs with greater than 15 percent CFR review responsibility from each ship except WEM. Only two of the 10 SBSs are able to

maintain their response times below the three-day prescribed turnaround rate when being assigned greater than 15 percent of all CFRs. SBS 4, is assigned to HOW where the distribution of CFRs is nearly even because there are three total SBS assigned to the availability.

In any case where they are assigned greater than 40 percent of all CFRs, the SBS are not able to maintain turnaround rates less than four days.

Table 4. CFR Responsibility and AVG Response Time

	SBS 1	SBS 2	SBS 3	SBS 4	SBS 5	SBS 6	SBS 7	SBS 8	SBS 9	SBS 10
% of Total CFRs	58.06%	55.60%	40.67%	27.44%	26.82%	26.46%	22.53%	16.53%	15.42%	15.11%
Response AVG	7.80	4.23	6.41	2.98	6.65	5.46	4.56	3.38	2.61	4.52

This table is a comparison of percent CFRs assigned above 15 percent and AVG response time for the BXR, DEC, HOW and HPR prepared by LT Donald Northrup. The data for this table was consolidated from Naval Maintenance Database.

Table 5 displays that the WEM was able to evenly distribute the CFR load across the three assigned SBS and they were able to maintain their response times below the prescribed rate. In addition, the WEM RCC turnaround average was less than three days as seen in Figure 13.

Table 5. CFR Responsibility and AVG Response Time for WEM

	SBS 1	SBS 2	SBS 3
% of Total CFRs	29.02%	39.63%	31.36%
Response AVG	2.08	2.17	2.56

This table is a comparison of percent CFRs assigned above 15 percent and AVG response time for the WEM prepared by LT Donald Northrup. The data for this table was consolidated from Naval Maintenance Database.

THIS PAGE INTENTIONALLY LEFT BLANK

V. MICRO PROCESS ANALYSIS

A. LEAN PROCESSES AND MUDA

Muda is the Japanese word for waste and Goldberg and Weiss use this word to describe the 8 categories of waste. This thesis specifies three of the waste categories to draw attention to those areas most apparent in the study:

- Waiting and Queuing–Any form of waiting with no production is wasteful. In general this is identified as works in progress that are waiting to begin the next process. This is the reason why leaning begins with slowing the entire process down to the throughput rate of the bottleneck. It allows the bottleneck to dictate the pace and the rest of the equipment used for other tasks.

- Mistakes (defects)–Any defects which require rework or remanufacturing another product.

- Untapped creativity and human potential–Thoughtful ideas to remove waste can be generated by those operating within the process. Constant process improvement requires these ideas and the perseverance of human capital.

(Goldberg & Weiss, 2015, p. 90)

a. Mistakes (Defects)

The MKI and BXR case study display a significant element of mistakes. The two ships saw 18.3 percent and 13.9 percent of RCCs returned to the contractor for revision of their COPAs, respectively. There are a couple of different elements that may contribute to resubmissions of COPAs. The contractor may not have understood the requirements, historical information was found which showed the COPA to be significantly over priced or the work proposed was not what the government requested. In any of these cases, communication and process improvement discussions with the contractor could lead to less resubmissions and ultimately a better functioning process.

Cost estimation is a form of defect for this process because there are a number of jobs where the cost is not estimated correctly by the government. At the same time this is creating double work. When the original cost estimation is incorrect or invalid the CT must conduct research of historical data to derive a cost estimate that can be used in

negotiation. When the CT has to redo the work conducted by the SBS it invalidates the time spent by the SBS, creating waste.

Proving this specific metric with quantitative data is difficult because the number of man hours spent in preparation for negotiation is not tracked. Without the number of hours spent in negotiation being tracked a comparison cannot be made to differentiate the time spent with an accurate cost estimate versus an inaccurate cost estimate. In addition GAP codes are not applied in a standardized manner to ensure tracking of inaccurate requirements.

The proof of inaccurate estimates comes from multiple interviews with PMs and ACOs. Multiple PMs specified that inaccurate cost estimates are leading to increased wait times on RCCs. ACOs have specified that there are times when they prepare for negotiations without a baseline for comparison due to inaccurate cost estimation data.

Reducing mistakes and defects is dependent on quality control. The PM review is the step in the process that is used for quality control. The PM is charged with reviewing every RCC and IGE.

b. Untapped Creativity and Human Potential

The CTs and in some cases the MTs are collecting and maintaining data to improve their processes. A lot of the process data for this thesis came from this sort of data collection. The problem is there is a department in the RMC which is dedicated to data collection and distribution and there is a tool which is supposed to be used to gather that data for the teams. NMD is designed to collect most of the data that is being tracked separately. With increased effort from the MTs and the CTs to input these data points into the system this waste could be reduced.

In some cases, the data points are tedious and require multiple entries. That type of feedback needs to occur so that adjustments can be made to improve the system. Beyond this, the MTs and CTs are preparing the awards board reports manually, even though these reports are all collectable in NMD. The inherent problem with individual MTs and CTs collecting this data and calculating it themselves in Excel is the accuracy of

the data is dependent on the experience level of the user. This makes the metrics by which the contractor is being reviewed less objective. If a central authority was in charge of the metrics, with a means to dispute the metrics for the MT and CT prior to awards board, the metrics could become more objective. Standardization of metrics, and using the Metrics Department to lead the effort, is important for objectivity but it is also important for avoiding potential manipulation.

Another point to consider in regards to metrics is agreement between the contractor and government on metrics standards. The contractor has grounds to refute the appearance of subjective claims if the government and contractor never agreed on the parameters of a metric in advance. For example, the contractor uses business days for measurement of processing times for reports. The government uses actual days.

B. THEORY OF CONSTRAINTS AND WAITING/QUEUEING

The theoretical bottleneck for four out of five of the ships is the SBS when processing the CFRs. Their maximum throughput rate experienced in the availability normalized to the rate of conversion of CFRs to RCCs returns the theoretical throughput rate. The MKI (See Figure 15) was the only maintenance team that was able to shift the theoretical bottleneck to the contracting team. In theory, the bottleneck is the SBS and in accordance with the theory of constraints the entire process should be slowed to the rate of the bottleneck. The resource constraint at the bottleneck is labor hours of the SBS conducting reviews of CFRs. To relieve the bottleneck the number of SBS should be increased to raise the capacity of the entire system.

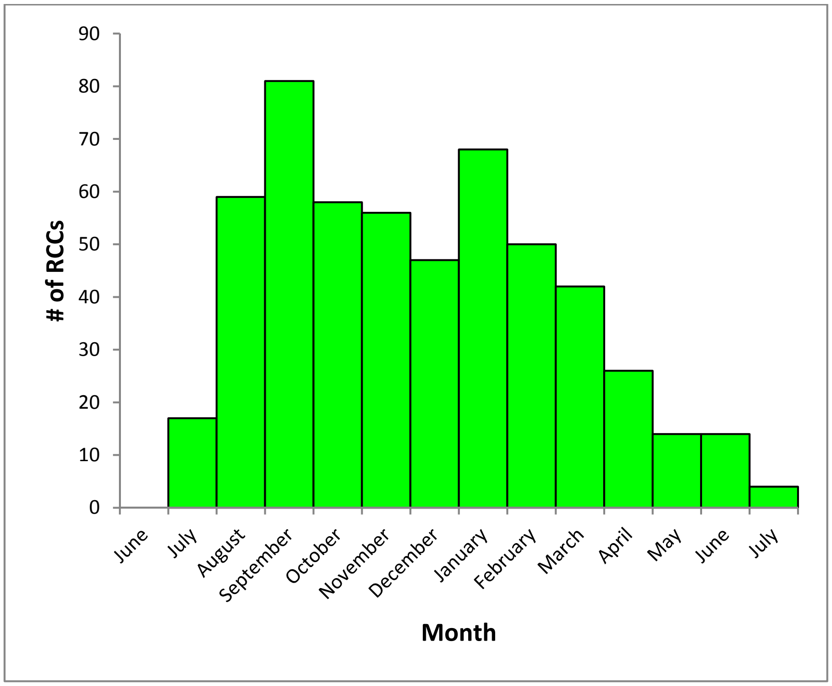
The problem with this particular system is that each entity has multiple responsibilities. The sole purpose of an SBS is not to review and approve RCCs and CFRs. For a full description of the responsibilities of the SBS, see the Appendix. With numerous and varied responsibilities comes the ability to concentrate on the most pressing tasks. This can be seen in all of the throughput rate charts. The level of effort exaggerates the waiting at individual tasks in the process.

In addition, the SBS is the primary resource constraint in both of the initial steps of the process meaning any deficiency in output by the SBS is exaggerated on the entire system. This makes the SBS crucial to timely processing of reports.

The theory of constraints requires the process pace be reduced to the bottleneck speed to make the process efficient. This reduces queuing times and wasted time over-producing reports which will wait in subsequent queues. In the event of a disparity in effort the most efficient mechanism for process improvement is to increase coordination. WEM displays coordination the best in Figure 14.

The rate of throughput increases and decreases naturally throughout the availability. In the beginning of an availability, work begins and reports rapidly increase as they are developed and submitted. As the availability continues report rates start to decline because the number of active jobs decreases. Additionally, the number of RCCs accepted starts to decline as growth work no longer fits in the prescribed window for the availability. Each ship's RCC submission histogram looks slightly different but HPR displays this trend in Figure 19. This figure displays the rapid increase in RCCs, which is directly proportional to the CFRs submitted. The middle of the availability is at a steady state with some variability and in the last couple months the pace of reports declines.

Figure 19. HPR RCC Submissions



This figure is a chart of the RCC Submissions for *USS Harper's Ferry* availability prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database.

Considering each of the ships in execution a trend emerges that four out of the five ships are reactionary in their throughput rate. WEM in Figure 14 displays a coordinated effort of the three entities as the level of effort is stepped up together. Each of the other ships displays a rapid increase in throughput for the MT. This is followed in the next month, or in some cases two months, by increases in effort by the contractor and the contracting team to meet the growth in queue.

a. Calibration of Effort

To maximize the efficiency in the process the three entities must coordinate their increase in effort. This is primarily done through constant communication. WEM's PM specified that there was never a CFR submitted to his MT without a verbal warning issued by the contractor. This allows the MT to reduce setup times by looking up historical data and finding and starting templates. This communication must be coupled with verbal warning back to the contractor of incoming RCCs and then communicating

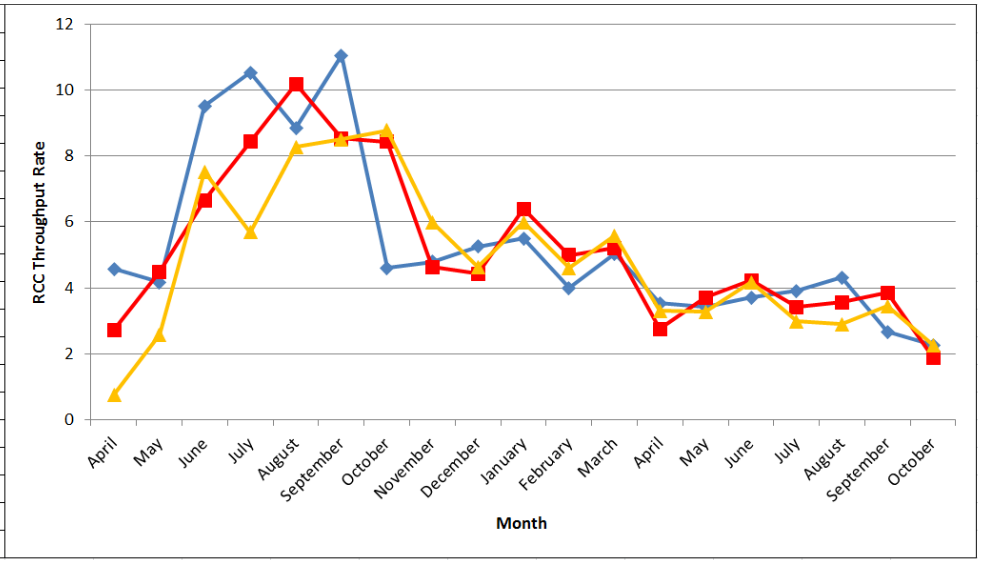
the rate of submissions to the contracting team to allow them to prepare for the impending response from the contractor. A contracting team could be working on as many as five availabilities at one time. The contractor is executing multiple contracts at once. The SBS, the reviewer of CFRs and creator of RCCs, is also responsible for monitoring the contractor on site, conducting check points and creating independent government estimates. Constant communication is instrumental to the three entities shifting their focus before a buildup in their respective queue.

The table attached to Figure 20 is the average of total RCC cycle times for each month of PHB's availability. Figure 20 is also the chart for PHB's throughput rates throughput the ship's availability. They are coupled in this figure for ease of reference. From the months of April to October the largest disparity in effort between the three entities exists. This period is also where the worst cycle times of the availability are found. In June, when the CT and Contractor are close in output, the average cycle time for the availability is at its lowest for that period.

In January and February, when the three entities move jointly the cycle times fall to their lowest to that point in the availability. From February to July, when the throughput rates are as close to identical as they get for the availability, the cycle times are at their lowest. Finally, in August and September when the level of effort diverges, the cycle time increases by approximately three working days. This ship shows that there is a correlation between congruence in throughput rate and overall cycle time for the availability. The slight divergence leading to an increase in approximately three days of cycle times shows this is significant.

Figure 20. PHB RCC Cycle Time and Throughput Analysis

PHB	AVG CT
Apr 14	25.57
May 14	26.01
Jun 14	19.37
Jul 14	23.56
Aug 14	23.37
Sep 14	21.72
Oct 14	23.64
Nov 14	17.96
Dec 14	20.36
Jan 15	16.61
Feb 15	13.77
Mar 15	12.61
Apr 15	13.32
May 15	12.49
Jun 15	11.46
Jul 15	12.29
Aug 15	15.07
Sep 15	15.91
Oct 15	11.86



This figure is representative of the throughput of RCC Submission, COPA Response and ATP throughout execution of the *USS Pearl Harbor* availability with a table of RCC Cycle time by month prepared by LT Donald Northrup. The data for this chart was consolidated from Naval Maintenance Database and data kept by the *USS Pearl Harbor* contracting team.

C. RELATIONSHIP ANALYSIS

Dyer specifically speaks to the ease of adjusting internal procedures and practices to improve efficiency (Dyer, 2009). Chrysler's second stage of process improvement required involving the supplier in product development and process improvement which was more difficult because it required changing the nature of their relationship. This second statement is what begins to draw comparisons with depot maintenance in the Navy. Table 6 displays the chart Dyer and Ouchi use to draw comparisons between the traditional U.S. model of supplier relations to the Japanese partnering model.

Table 6. Characteristics of Vendor Relations in Japan and the United States

Table 1 Characteristics of Vendor Relations in Japan and the United States

Traditional U.S. Model	Japanese Partnering Model
Department or firm focus,"optimize firm efficiency."	Business system focus (include supplier/ customer economics, "optimize value chain efficiency."
Emphasis on unit cost/price (minimum quality standards).	Emphasis on full value chain (systems) costs as well as on improving quality.
Manufacturer defines needs; specialization of activities; sequential planning.	Joint efforts to define needs and problem solve; highly integrated operations and planning.
Communication is sporadic, problem driven; little sharing of information or assistance.	Communication is frequent and planned; continuous sharing of information and assistance.
General investments; uniform approach.	Customized investments to meet unique customer or supplier needs (e.g., in information systems, people, manufacturing equipment, etc.).
Precise contracts that split economic benefits beforehand.	Flexible contracts that adjust to split economic gains fully as market conditions change.
No additional collateral bonds; arm's-length relationship.	Numerous collateral bonds employed to build trust and align the firms' financial fortunes and safeguard customized investments.

Source: Dyer, J. H., & Ouchi, W. G. (1993). Japanese-style partnerships: Giving companies a competitive edge. *Sloan Management Review*, *35*(1), 51–63

The traditional U.S. model from 1993 parallels the current status of Surface Navy depot maintenance. I provide the comparable terminology or precedent the government uses for the most glaring line items that reflects a difficult relationship between the government and its suppliers.

Department or Firm Focus: Three out of four data points used to characterize success in the Duncan and Hartl (2015) study are focused on results metrics for the government instead of value chain process improvement. GW/NW is the combination of the cost of growth and new work added during the availability with no framework for the cost driver or issues with the process. Specifically, these metrics do not account for the cost proposal initially made by the contractor, it only accounts for the definitized cost from the contract and the final settled value.

Lost Operational Days is schedule compliance as the difference between the contracted date of completion and the actual date of completion. This metric provides no context as to the problems with the process which is the same for On-Time Completion.

In the end, the government is most concerned with reducing the cost incurred which is reflected in the decision to increase competition and shift risk to the contractor. Increasing efficiency along the entire value stream will reduce costs across both parties, build trust and retain a healthier industrial base.

Government defined needs, specialization and planning: The government spends time writing the precise procedure (EPCP/PCP) for conducting work that is beyond the technical authority of the MT. In some instances, decentralized decision making, including decisions made by the contractor could be technically acceptable. They require proper oversight by the MT and follow up by technical authority, but the contractor is never given the opportunity to suggest a procedure.

In addition, the contractor has no incentive to be innovative in saving the government money. This requires a cost sharing contract structure such as an incentive type contract. This type of contract would negotiate the sharing percentage of saved money in advance of the contract. Additionally, it could share losses incurred up until a pre-defined point.

Communication is sporadic and problem driven: Weekly meetings are conducted with ships force to update the crew on status of job completion in addition to a weekly meeting between the commanding officer of a ship, the RMC CO, the PM, PE and a contractor representative. The central focus of this meeting is the status of the ship's availability. Process improvement meetings are happening regularly within the RMC but a contractor representative is not participating in process improvement measures. The act of including the contractor and including their suggestions for improvement throughout the entire process would bear full value stream process improvement.

Precise contracts which split economic benefits beforehand: As previously stated, there is no sharing of economic benefits with the contractor. Any money saved by the contractor is recouped by the government, which provides no incentive for the contractor

to perform more efficiently. This is especially true now that the government is shifting to fixed-price contracts and away from cost-plus contracts where the contractor may have won an award fee.

MSMO contracts were supposed to increase cooperation between the contractor and the government and reverse an inefficient relationship (Duncan & Hartl). The act of changing the contract type to better benefit the contractor, to a cost plus award fee type, is only half of the equation required to improve the relationship. Dyer points out that it is the easier piece of the equation to execute (Dyer, 1995). Including the contractor in process improvement, rewarding the contractor for increased efficiency, constructive communication on a regular basis and actually building trust with the contractor is the more difficult, but necessary task.

Until the Navy RMCs build functioning relationships with the contractor, there is no contract type that will fix the Navy’s cost and schedule issues.

VI. RECOMMENDATION AND CONCLUSION

Chrysler and GM proved in the early ’90s that organizations can learn lessons and change their processes. These automakers observed their competitors and implemented policies which ultimately increased efficiency and profit margins. The Navy’s maintenance organization can do the same in the current environment.

A. RECOMMENDATIONS

The current construct is a teaming arrangement between the contractor and the government. Cooperation between the parties should occur on a regularly scheduled basis to discuss process improvement.

<u>Recommendation 1</u>: Schedule weekly or bi-weekly meetings between executive level leadership of the local RMC and the contractor to review processes, consider improvements and discuss progress.

<u>Recommendation 2</u>: Increase the number of SBS assigned during a standard availability. Theoretical Bottleneck on four out of five ships is the SBS based on maximum capacity and conversion from CFR to RCC. In addition, the dependency of both of the first two steps of the process on the same resource, the SBS, results in greater need of SBS to properly reduce the bottleneck.

<u>Recommendation 3</u>: Increase communication levels and coordination between MT, KTR and CT. The level of effort is increasing waiting times at individual work stations. Verbal "heads up" from the contractor on ALL CFRs was observed to help reduce setup times. A second related recommendation is required reports of queue levels above a prescribed level to the CO of the RMC. This applies to all three entities to aid the process improvement review with the contractor.

<u>Recommendation 4</u>: Increase quality control standards and increase accountability for PMs. Rework is an issue. It is the responsibility of the PM to review the RCC and IGE. If available, shift more of the review burden to the Project Officer. Based on the ships reviewed, an RCC to WI ratio greater than three requires a review of the MT

practices by a senior PM. Additionally, RCC to WI ration greater than three should be addressed with the contractor charged with advanced planning. Potential loss of award fees is warranted for excessive changes.

Recommendation 5: Invest in increasing user friendliness of NMD and mandate its use by the MT. This will increase user input, which will allow for more granularities in metric analysis. It will also reduce the man hours used tracking metrics by the MT/CTs. Lastly, it will increase objectivity used for award fee board metrics.

B. IS THE NAVY'S CURRENT CONSTRUCT PREPARED TO SHIFT TO A NEW CONTRACTING STRATEGY?

As stated in Chapter I, when choosing contract types the FAR is explicit about items that should be considered. For this particular case two items directly apply:

- The government should compare a cost estimate to the contractor to provide the basis for negotiations. It is essential to consider the amount of uncertainty within the scope of work to apply a fair amount of responsibility on the contractor for cost.
- The higher the complexity of the work should result in a higher assumption of risk by the government. As a requirement recurs the risk should shift, in time, to the contractor.

(FAR 16.104)

The government should assume a higher percentage of the risk for jobs with high complexity. The complexity of the work to be performed is judged by the level of uncertainty within the project as specified by the first consideration. At this time, the government is changing the contract greater than two times per work item in six out of seven ships with available data. In one instance five times per work item (see Table 2, p. 54). This implies that a high level of complexity still exists for the work being performed.

Additionally, both of these considerations are based on the premise that an efficient and fully functional process is in place for estimating cost and defining recurring requirements. As previously discussed, the process requires adjustment within the firm and increased coordination with the contractor.

Until the process is improved, the government should assume the higher percentage of risk and shifting to a new contracting strategy is not recommended.

C. IS THIS NEW CONTRACT STRATEGY THE BEST DECISION FOR REDUCING COST AND KEEPING SCHEDULE?

No, as previously discussed, the government is not in a position to shift more of the risk to the contractor. Therefore, the best decision for reducing cost and keeping schedule is to improve the process until such time as requirements can be accurately defined. Instituting the prescribed process improvement recommendations coupled with increased coordination with the contractor will result in an environment where requirements can be scoped to an acceptable level for shifting risk to the contractor.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX. LIST OF SHIPBUILDING SPECIALISTS' RESPONSIBILITIES

The full list of SBS Action Items from the SWRMC SBS Desk Guide:

a. Review and comply with this desk guide and all applicable laws, references, SWRMC Instructions and guidance provided by the Government of the United States, U.S. Navy, PACFLT and SWRMC.

b. After assignment to a project/availability by the Class Team Leader and assignment of work items by the Project Manager, obtain and review all drawings, technical manuals, design memos, manufacturer's instructions and references required by the work item(s).

(1) Ensure the current version of the NAVSEA Standard Items is utilized.

(2) Review all work specifications assigned to you for technical and quality accuracy in addition to compliance with Volume 7, Chapter 4 appendix 4-E of JFMM. Submit an Engineering Service Request (ESR) for technical review if required.

(3) Review/Update NMD checkpoint module for each work item assigned to you ("G" points only)

During Advance Planning, the SBS will conduct specification reviews and develop an Independent Government Estimate as required.

c. Inspect the work site, when allowed by the Project Manager, before the start of the contract and note any conditions that are not in accordance with work items, will disrupt schedules, or cause additional work requirements. Document these conditions and alert the Project Manager for direction. Examples include, missing lagging, loose deck plates, piping interferences, etc.

d. Review the references for applicability to actual conditions and ensure the contractor adheres to the requirements of all work items and is using references that were in place at contract award.

e. Maintain a significant events logbook daily and additional records

f. Review contractor's schedules for purchase orders/government furnished material(GFM)/contractor furnished material(CFM), long lead time material (LLTM) lists, as applicable, to ensure material required is ordered and has acceptable Estimated Delivery Dates (EDD) to support the schedule. Anticipate and initiate actions that may be necessary to minimize schedule impact by unsatisfactory material delivery dates.

(1) Inform the Project Manager of any anticipated or ongoing work stoppage or problems concerning a work item based on government furnished equipment (GFE), GFM or delay in government furnished information (GFI), such as issues with contracting a work item to a subcontractor or answering of reports. These instances shall be documented in the significant events logbook

g. Conduct oversight coordination and inspection of work-related environmental issues associated with Ship's Force and contractor's operations. This effort includes but is not limited to hazardous material (HAZMAT) and hazardous waste (HW) handling, removal, storage, transportation and disposal.

As directed by PM, conduct safety inspection jointly with contractor, Ship's Force and Government Environmental Safety and Health (ESH) Representatives.

h. Observe check points identified in the work specification when they are presented by the contractor, witnessing required equipment or systems tests, accomplishing random in-process inspections at the work site to determine contractor compliance with the requirements of the specification, and determining the effectiveness of the contractor's QA program. Enter all G-checkpoints in NMD.

i. Review, evaluate and answer contractor's condition found reports (CFRs) including their recommendations for additional work and provide rationale for approval or disapproval

j. Make decisions to ensure quality of the product such as, but not limited to work item clarity, material requests, quality assurance requirements, etc. within their span of control and are not constructive changes or deviations to the contract.

> (1) A constructive change to a contract occurs whenever the government through its action or lack of required action causes the contractor to depart from plan or perform other than as specified in the contract. Ensure a Request for Contract Change (RCC) is written for any contract modification to prevent a constructive change to occur.
>
> (2) A deviation is defined as any action which is not in accordance with the work item, no matter how minor. Deviations require technical authority action–if approved, an RCC will be required to initiate the work. Failure to write an RCC will cause a constructive change to occur.

(3) When working outside of one's specialized skill set, request assistance from other Shipbuilding Specialists, Quality Assurance Specialist (QAS), Project Support Engineer (PSE), or the Project Manager as required making the best possible decision.

k. Initiate action(s) such as, but not limited to writing Requests for Contract Change (RCC), Corrective Action Report (CAR) Engineering Service Request (ESR), Progress reports or the coordination of efforts to prevent problems or work stoppages.

(1) Initiate either a method A or method B **C**orrective **A**ction **R**equest (CAR) when required

(2) Write new and growth work items when requested by the Project Manager and create RCCs when an existing work item requires contractual modification.

(3) Calculate estimates using historical costs in NMD, trade knowledge, vendor quotes, ship checks, business climate and information from Project Manager and other Shipbuilding Specialists.

(4) Develop, review and assist in negotiating modifications to original/new work specifications for work to be accomplished by contractors. Assist the ACO with the Government negotiation position.

l. Determine the physical progress, as a percentage of work completed, of each work item and each contract modification assigned. This information is updated weekly in the Navy Maintenance Database (NMD) that is used in calculating the contractor's entitlement to progress payments as well as in evaluating the contractor's schedule performance.

m. When assigned to a MSMO contract, the Shipbuilding Specialist shall accomplish cost monitoring duties

n. Maintain effective lines of communication between the Project Manager, Contractor, Ship's Force, Planning Yard on-site rep, and Alteration Installation Teams (AITs) for the purpose of problem solving, coordination and mutual discussion of work items.

(1) Provide current information and progress updates relating to assigned work items to the Project Manager

(2) Interface with members of the Ship's Force to provide current project information, notify responsible personnel of scheduled evolutions and solicit required or desirable Ship's Force assistance.

(3) Work with Planning Yard on-site representatives and engineering liaisons to help resolve technical problems.

o. Attend daily coordination; weekly progress; work coordination; work item scoping meetings as well as other meetings scheduled and unscheduled as determined by the Project Manager.

p. The Shipbuilding Specialist assigned weekend or night shift work shall perform duties in accordance with Chapter 2 Section B of this desk guide.

q. Investigate as necessary the contract guarantee to help determine whether failure of equipment or systems covered by the guarantee clause is the responsibility of the Government or the contractor.

r. Provide lessons learned and feedback reports related to deficient or inefficient work specifications or work authorizations to the appropriate planning group for use in improving future maintenance requirements. Provide written reports to support Lessons Learned Conferences, Award Fee Evaluations and the Contractor Performance Assessment Reporting System (CPARS).

(Waterfront OPS, 2011, pp. 15–18)

LIST OF REFERENCES

Beardsley, 2015. *New CNO must balance needs and capabilities.* Stars and Stripes. Retrieved from http://www.stripes.com/news/new-cno-must-balance-needs-and-capabilities-1.375213

Commander Navy Regional Maintenance Center. (2012). About Commander Naval Regional Maintenance Center [Fact sheet]. Retrieved from www.navsea.navy.mil/CNRMC

Commander Naval Regional Maintenance Center (CNRMC). (2015). *About CNRMC.* Norfolk, VA: CNRMC.

Commander Naval Regional Maintenance Center. (2015). *Bid Spec/Work Spec Review Process Improvement Event Summary.* Washington D.C. CNRMC

Cucmano, M. (1991). Supplier relations and management: A survey of Japanese, Japanese-transplant and U.S. auto plants. *Strategic Management Journal*, *12*(8), 563–588.

Definitization. n.d. Retrieved October, 10, 2015, from http://www.businessdictionary.com/definition/definitization.html#ixzz3qRvwfDh9

Department of the Navy. (2015). *President Budget Submission*. Retrieved from http://www.secnav.navy.mil/fmc/fmb/Pages/Fiscal-Year-2016.aspx

Duncan, M. E., & Hartl, R. P. (2015). *Multiple award, multiple order contracts—The future of Navy surface maintenance procurement.* Monterey, CA: Naval Postgraduate School.

Dyer, J. H. (1996, July–August). How Chrysler created an American Keiretsu. *Harvard Business Review*, 42–56.

Dyer, J. H., & Ouchi, W. G. (1993). Japanese-style partnerships: Giving companies a competitive edge. *Sloan Management Review*, *35*(1), 51–63.

Executive Director SUBMEPP. (2015). *Joint fleet maintenance manual.* Portsmouth, NH: Department of the Navy.

Goldberg, R., & Weiss, E. (2015). *The lean anthology a practical primer in continual improvement*. Boca Raton, FL: CRC Press.

Hammer, M., & Champy, J. (2001). *Reengineering the corporation.* New York, NY: Harper.

National Steel and Shipbuilding Company. (2012). *Military ship repair programs purchase order special terms and conditions for the FFG MSMO program Contract Number N00024-10-C-4306.* Norfolk, VA. NAASCO. Retrieved from: http://www.nassconorfolk.com/pages/purchasing/Special%20Terms%20and%20Conditions%20for%20the%20FFG%20MSMO%20Program%20Rev1.pdf

Naval Sea Systems Command (NAVSEA). (n.d.-a). NAVSEA 21 program summary. Retrieved from http://www.navsea.navy.mil/Home/TeamShips/NAVSEA21.aspx

Naval Sea Systems Command (NAVSEA). (n.d.-b). NAVSEA corporate leadership [Chart]. Retrieved from http://www.navsea.navy.mil/WhoWeAre/Headquarters.aspx

Naval Sea Systems Command (NAVSEA). (n.d.-c). SURFMEPP: Core products. Retrieved from http://www.navsea.navy.mil/Home/TeamShips/NAVSEA21/SURFMEPP/CoreProducts.aspx

Naval Sea Systems Command (NAVSEA). (n.d.-d). SURFMEPP: Mission statement. Retrieved from http://www.navsea.navy.mil/Home/TeamShips/NAVSEA21/SURFMEPP/MissionStatement.aspx

Office of the Chief of Naval Operations. (2010). *Maintenance policy for United States Navy ship* (OPNAVINST 4700.7L). Washington, DC: Department of the Navy.

Rendon, R., & Snider, K. (2008). *Management of defense acquisition projects.* Reston, VA: American Institute of Aeronautics and Astronautics.

Supervisor of Shipbuilding, Conversion & Repair. (2015). *SUPSHIP operations manual (SOM).* Washington Navy Yard, Washington, DC: SUPSHIP.

Waterfront OPS. (2011, August 17). *Shipbuilding Specialist (SBS) Desk Guide*. San Diego, CA: Southwest Regional Maintenance Center

World Maritime News. (2014). *BAE Systems Seals Maintenance Deal with Navy.* Retrieved on December 3, 3015 from: http://worldmaritimenews.com/archives/122319/bae-systems-seals-maintenance-deal-with-us-navy/

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California